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A SYSTEM OF GYNECOLOGY AND OBSTETRICS

BY AMERICAN AUTHORS.

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OBSTETRICS.

VOLUME II.—PART I.

ILLUSTRATED WITH WOOD ENGRAVINGS.

EDINBURGH AND LONDON :
YOUNG J. PENTLAND.

1889.

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CONTENTS OF VOLUME II.

	PAGE
DISEASES AND ACCIDENTS OF LABOR. By THEOPHILUS PARVIN, M. D., LL. D.	17
THE FORCEPS.—EMBRYOTOMY. By EDWARD P. DAVIS, A. M., M. D.	121
THE PREMATURE INDUCTION OF LABOR. By JAMES C. CAMERON, M. D.	194
VERSION. By JAMES C. CAMERON, M. D.	209
THE CÆSAREAN OPERATION, SYMPHYSIOTOMY, LAPARO-ELY- TROTOMY, AND LAPARO-CYSTEOTOMY. By ROBERT P. HARRIS, A. M., M. D.	247
PUERPERAL INFECTION. By HENRY J. GARRIGUES, A. M., M. D. . . .	290
INFLAMMATION OF THE BREAST AND ALLIED DISEASES CON- NECTED WITH CHILDBIRTH. By HENRY J. GARRIGUES, A. M., M. D.	379
THE ETIOLOGY OF PUERPERAL FEVER. By HAROLD C. ERNST, M. D.	401
SOME COMPLICATIONS OF THE PUERPERAL STATE INDEPEND- ENT OF SEPTIC INFECTION. By BARTON COOKE HIRST, M. D. . .	461
INSANITY AND DISEASES OF THE NERVOUS SYSTEM IN THE CHILDBEARING WOMAN. By JAMES HENDRIE LLOYD, A. M., M. D.	545
THE MANAGEMENT AND THE DISEASES OF THE NEWBORN IN- FANT. By J. LEWIS SMITH, M. D.	633
THE SURGICAL DISEASES OF INFANCY AND EARLY CHILDHOOD. By STEPHEN SMITH, A. M., M. D.	763
CONGENITAL ANOMALIES OF THE EYE. By G. E. DE SCHWEINITZ, M. D.	821

LIST OF WOOD ENGRAVINGS.

FIG.	PAGE
1. Annular Laceration of the Cervix	18
2. Transverse or Semicircular Grinding Through of the Uterus	19
3. Three Degrees of Inversion of the Uterus	41
4. Inversion of Uterus, from specimen in Musée Dupuytren	42
5. Vaginal Tampon in Placenta Prævia	60
6. Arresting Hemorrhage by Compression of Uterus	68
7. Rueff's Forceps	122
8. Palfyn's Forceps, joined by Heister	123
9. Rathlaw's Forceps	124
10. Chamberlen's Forceps	125
11. Levret's Forceps	126
12. Smellie's Forceps	126
13. Hubert's Axis-traction Forceps	127
14. Tarnier's Forceps, first model	127
15. Tarnier's Forceps, modified	128
16. Simpson's Forceps	129
17. Simpson's Axis-traction Forceps	129
18. Naegle's Forceps	130
19. Breus' Axis-traction Forceps	130
20. Lusk's Tarnier Forceps	131
21. Hodge's Forceps	131
22. Wallace's Forceps	131
23. Elliott's Forceps	132
24. Smith's Forceps	132
25. Sawyer's Forceps	133
26. Pouillet's Axis-traction Forceps	134
27. Stevenson's Device for Axis Traction	134
28. Forceps at Inferior Strait	138
29. Protecting Perineum in Forceps Delivery	139
30. Forceps in Defective Occipital Rotation	140
31. Forceps in Face Presentation	142
32. Tarnier's Forceps applied to Breech	143
33. Forceps at Superior Strait	145
34. Birth-canal at End of Stage of Dilatation	147
35. Smith's Axis-traction by Leverage	148
36. Traction with Tarnier's Forceps	149
37. Delivery by Tarnier's Forceps at Perineum	149
38. The Vectis	162
39. Hodge's Craniotomy Scissors	165
40. Smellie's Scissors	165
41. Naegle's Perforator	165
42. Blot's Perforator	165
43. Martin's Trephine, parts together	166
44. Martin's Trephine, parts asunder	166

FIG.		PAGE
45.	Braun's Curved Trephine	166
46.	Simpson's Cranioclast	167
47.	Braun's Cranioclast	167
48.	Hicks' Cephalotribe	168
49.	Blot's Cephalotribe	168
50.	Breisky's Cephalotribe	169
51.	Lusk's Cephalotribe	169
52.	Simpson's Basilyst	170
53.	Tarnier's Basiotribe	171
54.	Application of Tarnier's Basiotribe	172
55.	Basiotripsy Accomplished	172
56.	Crotchets	172
57.	Craniotomy Forceps	173
58.	Braun's Hard-rubber Tube	173
59.	Hard-rubber Syringe	173
60.	Use of Simple Perforator	174
61.	Craniotomy with Martin's Trephine	175
62.	Head after Delivery by Cranioclast	176
63.	Braun's Decapitation Hook	179
64.	Decapitation by Hook	179
65.	Tarnier's Apparatus for Feeding Premature Infants	201
66.	Braun's Colpeurynter, dilated	205
67.	Barnes' Fiddle-shaped Hydrostatic Bag	205
68.	McLean's Modification of Barnes' Hydrostatic Bags	206
69.	McLean's Bags, dilated	206
70.	Tarnier's Cervical Dilator, unexpanded	207
71.	Tarnier's Cervical Dilator, expanded	207
72.	Tarnier's Cervical Dilator, <i>in situ</i>	207
73.	Pinard's Abdominal Supporter, side view	213
74.	Pinard's Abdominal Supporter, front view	213
75.	Version in Transverse Presentation	215
76.	Version in Breech Presentations	216
77.	Internal Podalic Version, French method	220
78.	Internal Podalic Version, German method	221
79.	Braxton Hicks' Method of Combined Podalic Version	222
80.	Braxton Hicks' Method, second stage	223
81.	Braxton Hicks' Method, third stage	224
82.	Braxton Hicks' Method, final stage	224
83.	Podalic Version in Head Presentation	225
84.	Braun's Repositor, arranged as Noose-carrier	227
85.	Male Gum-elastic Catheter, used as Braun's Repositor	227
86.	Male Gum-elastic Catheter, as Noose-carrier	227
87.	Male Gum-elastic Catheter, as Noose-carrier, German method	228
88.	The Stilette	228
89.	Podalic Version when Arm is Prolapsed	230
90.	Method of Lifting Impacted Shoulder from Brim	231
91.	Method of Liberating Posterior Arm	234
92.	Method of Liberating Anterior Arm	235
93.	Manual Extraction of After-coming Head—Smellie	237
94.	Manual Extraction of After-coming Head—Veit	238
95.	Manual Extraction of After-coming Head—Prague method	239
96.	Extraction when Chin is Arrested at Symphysis	239
97.	Wiegand-Martin Method of Extraction	240
98.	Forceps Delivery of After-coming Head, Dorso-anterior Position	242
99.	Forceps Delivery of After-coming Head, Dorso-posterior Position	242

FIG.	PAGE
100. Various Forms of Bandages	334
101. Puerperal Mastitis forming Abscess	387
102. Puerperal Mastitis, Glandular Variety	389
103. Lobules of Mammary Gland of Puerpera	390
104. Lower Half of Breast during Lactation	391
105. Miss Murphy's Breast-binder	393
106. Pigment of Areola following Incisions	396
107. Cultures of the <i>Streptococcus erysipelatis</i> , <i>Staphylococcus pyogenes aureus</i> , and <i>Streptococcus pyogenes</i>	453
108. Muscular Tissue of Pregnant and Puerperal Uterus	463
109. Uterine Muscle-fibres Nine Days Post-partum	463
110. Diagrammatic Representation of Decidua	466
111. Lochia on Seventh Day	466
112. Lochia on Second Day	466
113. Lochia on Fourth Day	466
114. Frozen Section of Puerperal Uterus	467
115. Chart showing Fever in Bilateral Laceration of Cervix	474
116. Chart showing Fever in Deep Laceration of Vaginal Wall	474
117. Fibrinous Polyp	478
118. Frozen Section of Puerperal Uterus in Antelexion	480
119. Retroflexion of Puerperal Uterus	480
120. Chart of Emotional Fever from Dread of Operation	493
121. Chart of Fever Case from Exposure to Cold	494
122. Chart showing Fever from Constipation in Puerperal State	495
123. Chart showing Reflex Fever from Mammary Congestion	496
124. Chart showing Fever followed by Expulsion of Tape-worm	497
125. Chart showing Fever following Perforation of Uterus	497
126. Chart showing Temperature in Eclampsia	498
127. Chart showing Temperature in Syphilitic Fever	500
128. Chart showing Influence of Labor on Temperature of Phthisis	501
129. Chart showing Fever in Muscular Rheumatism during Pregnancy	521
130. Mammary Gland of a Nullipara (Silesia)	536
131. Mammary Gland of a Nullipara (Silesia)	536
132. Mammary Gland of a Nullipara (Bavaria)	536
133. Mammary Gland of a Nullipara (Bavaria)	536
134. Acrania	653
135. Hydrencephalocele	656
136. Spina Bifida	658
137. Pavement Epithelium covered by Spores of <i>Oidium Albicans</i>	744
138. Spores and Branches of <i>Oidium Albicans</i>	745
139. Vertical Section through Umbilicus and Linea Alba	766
140. Supernumerary Little Finger	767
141. Supernumerary Thumb	767
142. Seton Inserted in Webbed Fingers	769
143. Diagram of Flaps in Operation for Webbed Fingers	769
144. Webbed Finger with Thick Septum	769
145. Operation for Webbed Fingers	770
146. Pulsating Vascular Tumor of Orbit	770
147. Cicatricial Contraction of Mouth	771
148. Large Mouth, Pendulous Growth near Ear	771
149. Showing Development of Intermaxillary Bone	772
150. Hare-lip, Congenital Cicatrix	772
151. Hare-lip as Slight Notch	772
152. Hare-lip as Deep Fissure of Right Side	772
153. Uncomplicated Double Hare-lip	772

FIG.		PAGE
154.	Fissure of Hard and Soft Palate	772
155.	Hare-lip complicated with Fissure of Alveolus	772
156.	Operation for Hare-lip, Position for Infant	774
157.	Elastic Compressor applied over Coronary Artery	774
158.	Application of Twisted Suture	775
159.	Twisted Suture	775
160.	Hainsby's Truss	775
161. }	Operation for Partial Hare-lip (Nélaton)	776
162. }		
163.	Operation for Double Hare-lip	777
164.	Malgaigne's Operation for Hare-lip	777
165.	Operation for Single Hare-lip	777
166. }	Collis' Operation for Hare-lip	777
167. }		
168. }	Hare-lip, Giraldès' Method	778
169. }		
170. }	Double Hare-lip	778
171. }		
172.	Complicated Hare-lip, before Operation	779
173.	Complicated Hare-lip, Front View	779
174.	Complicated Hare-lip, Side View after Operation	779
175.	Slight Fissure of Palate	780
176.	Large Fissure of Palate	780
177.	Hypertrophy of Tongue	783
178.	Strangulation of the Bowel	785
179.	Intussusception	785
180.	Intussusception of Cæcum	789
181.	Vaginal Fistula	798
182.	Imperforate Anus	797
183.	Incision for Imperforate Anus	798
184.	Band attached to External Wound in Operation for Imperforate Anus	799
185.	Meningocele	801
186.	Meningocele at Root of Nose	801
187.	Large Spina Bifida	804
188.	Congenital Coccygeal Tumor	805
189.	Wood's Operation for Extroverted Bladder	807
190.	Wood's Operation for Extroverted Bladder, flaps applied	807
191. }	Bigelow's Operation for Extroverted Bladder	807
192. }		
193.	Irritated Congenital Phimosis	808
194.	Circumcision	808
195. }	Circumcision, Preparation of Flaps	809
196. }		
197.	Congenital Inguinal Hernia	810
198.	Infantile Hernia	810
199.	Encysted Form of Infantile Hernia	810
200.	Common Scrotal Hernia	810
201.	Cysts of the Cord: Encysted Hydrocele	811
202.	Hernia of Funicular Process	811
203.	Fascia at Umbilicus	812
204.	Congenital Umbilical Hernia	813
205.	Umbilical Truss	813
206.	"Greenstick" Fracture of Clavicle	815
207.	Club-foot, Talipes Equinus	816
208.	Club-foot, Talipes Calcaneus	817

FIG.		PAGE
209.	Club-foot, Congenital Varus	818
210.	Stretching Foot in Talipes Varus	818
211.	Varus Treated by Bandage	818
212.	Operation for Club-foot, before Operation	819
213.	Operation for Club-foot, Bones Removed	819
214.	Operation for Club-foot, after Operation	819
215.	Club-foot, Valgus	819
216.	Coloboma of Eyelids	822
217.	Cryptophthalmos	825
218.	Epicanthus	827
219.	Dermoid Tumor of Corneo-scleral Border	832
220.	Incomplete Coloboma of Iris	835
221.	Anophthalmos	838

DISEASES AND ACCIDENTS OF LABOR.

By THEOPHILUS PARVIN, M. D., LL.D.,

PHILADELPHIA.

LACERATIONS OF THE UTERUS.

TEARS of the uterus occurring in labor may be divided into those of the neck, of the body, and those of both neck and body.

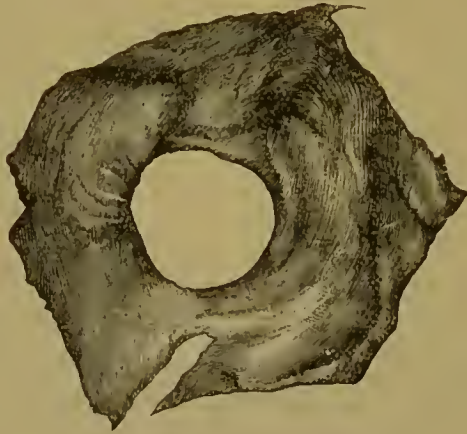
Tears of the Neck of the Uterus.—It almost invariably happens in a primipara that there is a transverse laceration of the vaginal portion in labor: this tear is generally deeper upon the left than upon the right side, but as a rule does not even in the former extend as far as the vaginal vault. So, too, some tearing of the os in labor usually occurs in multiparæ. But these are physiological tears, and only exceptionally demand the attention of the obstetrician. If, however, a tear of the cervix, whether of the vaginal portion alone or extending above it, is followed by hemorrhage, the recognition of the accident and immediate treatment may be required. Such injury is liable to occur if forceps be applied and extraction made before the os is sufficiently dilated; and so, too, podalic version and extraction under a similar condition may cause it. Remy¹ has reported a case of grave hemorrhage from a tear of the neck of the uterus; extraction of the presenting head was made by the forceps when the os was incompletely dilated, and the left side of the cervix was thereby torn. The hemorrhage was so serious that compression of the aorta was employed, and then a tampon was introduced and allowed to remain twenty hours; recovery.

The hemorrhage is the dominant immediate symptom, though the liability to septic infection created by such a tear ought also to be considered. Possibly hot-water injections or the introduction of a tampon of styptic cotton pressing directly upon the bleeding part may arrest the flow. But in case neither is used, or if both have been tried unsuccessfully, the suture furnishes a sure reliance. In its application we should, as advised by Schroeder, draw the uterus down with Museux's forceps or with a strong tenaculum until the injured part is exposed at the vulvar orifice; then the introduction of sutures will be comparatively easy: these sutures may be of silver wire or of silkworm gut.

¹ *Archives de Tocologie*, Oct., 1887.

During the operation the patient lies upon her back, the lower limbs well flexed upon the abdomen; of course antiseptics are carefully em-

FIG. 1.



Annular Laceration of the Cervix.

ployed. Very serious injury has been done to the cervix in instrumental labor by one blade of the cephalotribe or of the forceps being applied external to the os, and thus a part of the neck is seriously bruised or even actually torn away. To state that such accidents have occurred ought to be sufficient warning against the carelessness and ignorance that would render their repetition possible.

A few cases of what has been termed annular separation of the cervix have been recorded. This accident results from an unyielding cervix and strong uterine contractions. Barnes¹ refers to a case reported by Gervis in which ringform detachment was not complete. It was replaced without sutures, as the patient was very prostrate. She recovered, and the ring reunited. Duparcque² mentions meeting with a case in which the entire anterior lip was detached, so that at first it seemed as if there were a double os uteri.

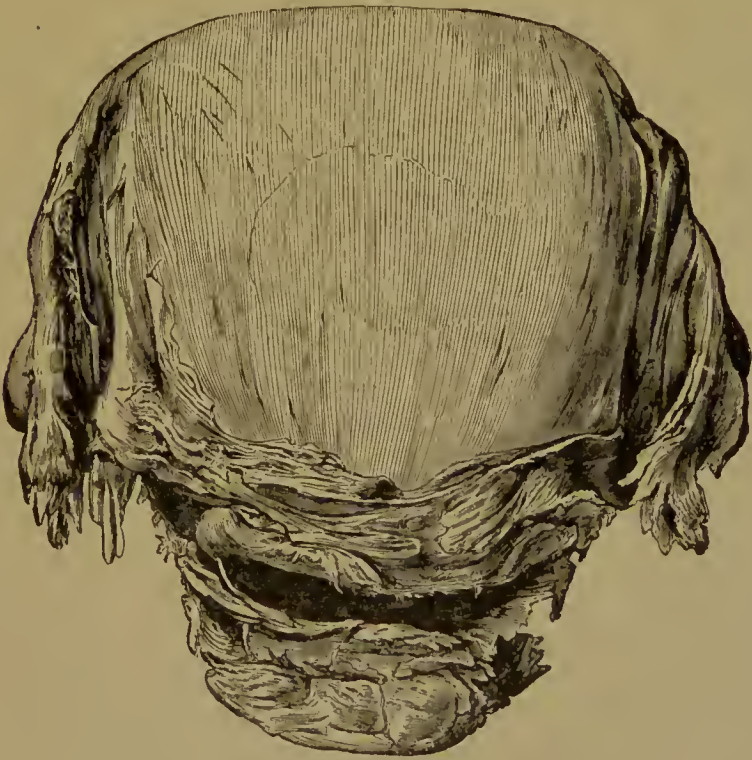
Rupture may be consequent upon attrition, the uterine tissue, usually cervical, being forced against abnormal bony projections from some portion of the pelvic inlet, exostoses of pelvic bones; and thus *usur*, a wearing away of those tissues, results. Naegele states that Kilian has drawn especial attention to a deformity of the ilio-pectineal eminence in which this, instead of presenting its normal oval shape, has a spine-like process; similar sharp projections may occupy other parts of the pelvis; to the basin thus deformed the name of *Stachelbecken*, pelvis spinosa, was given; and Kilian showed the injurious effect in labor

¹ *Obstetric Medicine and Surgery*. A similar case will be found in the *Transactions of the Philadelphia Pathological Society*, vol. i., reported by Dr. Keller.

² *Histoire complète des Ruptures et des Déchirures de l'Utérus*, etc.

resulting from this cause. Depaul has stated that four out of twenty-four deformed pelves in his collection show exaggerated developments of particular parts, forming knife-like projections; according to his observation, this deformity was most frequent at the pubic crest. The following remarkable case is quoted by Dupareque:¹ A woman had been in labor twelve hours, the presentation being pelvic. The os uteri was not yet completely dilated when all the anterior part of the neck, from one side to the other, separated. Immediately the fœtus passed into the abdominal cavity, and it was extracted with great difficulty in less than two hours; it was dead. The mother died five hours after being delivered. The basin was found a little narrow; the point of the sacrum had passed through the posterior part of the uterus (was this the sacro-vertebral angle?); the internal and salient border

FIG. 2.



Transverse or Semi-circular Grinding-through of the Uterus.

of the pubis and of the iliac bones resembled somewhat the edge of a paper-cutter, and had cut all the thickness of the uterus as if it had been divided by a ligature. Brens² has published a case of injury done to the uterus by its tissues being worn through in consequence of

¹ *Op. cit.*

² "Ueber perforirende Usur des Uterus," *Wien. med. Blatter.*

the pressure of the head of the child, forcing these tissues against the sharp promontory of a rachitic pelvis.

Rupture of the Body of the Uterus.—Ruptures limited to the body of the uterus have resulted from the giving way of eicatrices consequent upon a rupture in a previous labor or of a Cæsarean section. Barnes admits that in some cases of this accident excessive fatty degeneration of the muscular tissue of the organ was present. He adds, however, that to prove that a particular cause existed in a limited number of cases is very different from establishing it as a general or universal law; and there is abundant evidence to prove that in a considerable number of cases no such excess did exist. But of course cases belonging to these categories are very few, and we may assume, with Zweifel, that in some instances spontaneous rupture of the uterus results from a change, a displacement of the individual muscle-layers of the uterus.

Rupture of the Neck and of the Body of the Uterus.—By far the great majority of grave ruptures of the uterus involve the neck and the body, and the explanation of their occurrence given by Bandl is generally accepted. In normal labor the first stage is regarded as ending when the os uteri is so dilated that it offers no resistance to the presenting part, and this, therefore, under the influence of uterine contractions, descends and is expelled from the uterus, but with descent of the head, for example, ascent of the os uteri occurs. The activity of the uterus is exerted during that stage in a retraction of the os, drawing it upward over the presenting part. But if there be a marked disproportion between the presenting part and the canal it must pass through—as, for example, that caused by a shoulder presentation or a hydrocephalic head or by a narrow pelvis—advance is impossible; meantime, the uterine force struggling against an invincible obstacle, the effort at retraction of the cervix still continues, and the tissues of the cervix and of the lower portion of the body of the uterus are greatly stretched and attenuated. In consequence of the right obliquity of the uterus—this being the fact in the great majority of cases—the retraction as a rule is greater upon the left side than upon the right. “This explanation makes clear the reason for these ruptures always involving the cervical portion, and thence extending upward to the contraction-ring and downward into the cul-de-sac, and why they are in only rare instances directly longitudinal, but have an oblique or transverse course; their greater frequency upon the left side is not to be attributed to the greater frequency of the pressure of the head upon that side, but to the usually occurring right obliquity of the uterus and to the greater retraction of the left uterine wall.”¹ To the question as to why the vagina is not made tense, drawn up by this retraction of the cervix, the answer is

¹ Zweifel.

that the uterine ligaments antagonize the retraction of the cervix, and they become very tense, especially the round ligaments.

It is fortunate that the most frequent of uterine ruptures does not come without warning: there are almost always clear indications of the advent of the accident, so that the obstetrician may, in most instances, avert it. The premonitory symptoms are the tense condition of the round ligaments, the great thinning of the lower uterine segment, the ascension of Schroeder's contraction-ring (see Fig. 289, Vol. I.), so that from its normal position near the pelvic inlet it may now be only the breadth of two or three fingers below the umbilicus; this ring can be recognized by palpation, and during a uterine contraction can be seen making a somewhat obliquely-lying furrow across the abdomen, while at the same time that portion of the uterus below this furrow "is prominent as if it were a distended bladder;" but the use of the catheter will prevent, in a case of doubt, such mistake.

The finger in the vagina passes readily between the presenting part and the cervical wall, which is everywhere found extremely thin. The general condition of the patient also foretells the accident. She is restless, and suffers not only during uterine contractions, but also in the intervals; the abdomen is tender;¹ the suffering and the anxiety cause an excited and frequent pulse, and there is some elevation of temperature; her countenance expresses anxiety. Instances of this variety of rupture that do not present premonitory symptoms are quite exceptional.

Spontaneous and Traumatic Ruptures.—A rupture of the uterus is spontaneous when it occurs independently of obstetric intervention, whether this be manual or instrumental. On the other hand, the uterus may be torn by the introduction of the forceps blades through an undilated os, by slipping of the blades after their intra-uterine application, or by violently dragging the head through an undilated os; the application of the cephalotribe may be followed by the same result. So, too, it is probable that the accident frequently occurs from podalic version, either attempted or accomplished, when the symptoms of threatened rupture are present: even though the operator may in a given case accomplish this version with ease, as the last straw breaks the camel's back, so the slightest additional strain given by fingers or hand may determine tearing of the greatly-stretched lower uterine segment.

Frequency of the Accident.—Collins gives the proportion of cases of rupture of the uterus as 1 in 482 labors; McClintock, 1 in 737; Ramsbotham, 1 in 4429; Jolly, 1 in 3403; Bandl, 1 in 1200; Galabin, 1 in 3371. But all these statistics have possibly two sources of error. Fatal cases, though known by the obstetrician in attendance, do not

¹ Spiegelberg.

always find their way into medical journals or even into mortality statistics. Still others are not known even to the medical attendant at the time of the accident or during the subsequent illness; the patient dies of septicæmia or she may perish immediately of hemorrhage, and only the post-mortem reveals the cause of the infection in the one case or of the mortal bleeding in the other. Evidently, if an autopsy had not been made such cases would not have been known, and as comparatively few autopsies are made outside of hospitals, it is quite probable—nay, certain—that some cases of uterine rupture are unknown. Hervieux¹ narrates a case from the practice of Dubois in which he performed podalic version on account of narrowed inlet; the woman died the next day, no symptom of uterine rupture having been manifested, yet there was found at the post-mortem an irregular rent involving a part of the anterior wall of the vagina, the entire length of the neck in front, and a portion of the left side of the uterus. He also refers to a case occurring in the Maternité in his service in which Tarnier by external means changed a pelvic into a vertex presentation; the woman was delivered on the 9th and died on the 11th of November, and at the autopsy there was found a rent in the side of the neck a little more than two inches long, extending from the internal os to the union between the neck and the vagina. In a paper presented four years ago to the Philadelphia County Medical Society, I narrated a case of uterine tear which was not suspected during life, but, the woman dying of septicæmia, a post-mortem showed that there was a complete rent involving the left side of the cervix and the lower third of the body of the uterus. Since that time a medical gentleman of this city brought me the uterus of a woman who died in labor from hemorrhage, so reported too in the certificate to the Board of Health, and examination showed that the cause of the hemorrhage was a tear extending from the external os nearly as high as the contraction-ring. Hervieux remarks that in some cases the uterine tear is made silently—neither pain nor complaint nor crisis, and if the patient dies, as is usually the case, one is astonished to find at the autopsy a rupture which had not been even suspected.

If we add to these silent tears, many of which remain unknown because autopsies in private practice are not frequent, and a few in which death does not follow the accident, those cases which, though recognized by the practitioner, are not made known, it is probable that the accident, though by no means frequent, is less rare than published statistics indicate.

Causes of Uterine Rupture.—Duparcque in his well-known work stated as the first of his conclusions that ruptures of the uterus were caused by contractions of the organ. This view is also sustained by

¹ *Traité clinique et pratique des Maladies puerpérales.*

Tyler Smith, Trask, Jolly, and others—indeed, meets with general acceptance. Laying aside those comparatively rare instances in which the uterus is torn by obstetric intervention, whether manual or instrumental, and those instances of injury, also rare, in which change in the tissues at a particular part of the organ, whether from previous traumatism or from degeneration¹ has occurred, and therefore the weakened part yields even in normal labor, the greater number of cases of this injury result from undue resistance to the force of uterine contractions. The normal effect of that force is the expulsion of the child. But if some invincible obstacle is present preventing that expulsion, uterine contractions, strong and continued, end in uterine rupture. Such obstacle may be presented by pathological conditions of the utero-vagino-vulvar canal, by contracted pelvis, by a malpresentation, or by the abnormal size of the child, this increase being usually from a pathological condition, as hydrocephalus. In addition, rupture may occur without any of the conditions just mentioned, solely from the improper administration of ergot. A midwife, anxious to hurry the labor of a primipara, gives large doses of ergot in the first stage of labor, and the vigorous contractions of body and fundus striving against the normal resistance of an only partially dilated os, the organ is torn: I have met with an instance of this kind, and very many have been recorded by others.

That resistance of the os uteri from pathological changes, and that narrowing of the vulvo-vaginal canal, as from cicatrices, may lead to rupture of the uterus, have been proved by several cases of this accident which have been reported. Pelvic contraction is an important cause. Thus Trask² found in 417 cases “at least 74” of contracted pelvis.

The influence of the increased size of the foetus in causing rupture of the uterus is shown by the fact that the accident is much more frequent in male than in female births: in 34 cases of Collins, 23 were males; in 20 of McKeever, 15; in 13 of Bandl, 10; and thus in 67 cases of uterine rupture the sex of the children was in 48 male.³ A partial increase in the volume of the foetus has been observed in several cases of rupture of the uterus, as from ascites, abdominal tumors, and hydrocephalus. Keith⁴ found 16 cases of uterine rupture in 67 instances in which the foetus was hydrocephalic; in the statistics of

¹ Kormann (*Lehrbuch der Geburtshilfe*) refers to Windelschmidt's report of rupture of the uterus from changes in the structure of the muscular walls consequent upon placental endometritis of syphilitic origin. He also mentions the case of Saexinger, in which an abscess in the uterine wall led to the accident.

² *Am. Journ. Med. Sci.*, July, 1856. Trask's statement is thus given incorrectly by Charpentier (*Traité pratique d'Accouchement*): “Trask in 300 cases has noted in 74 per cent. of these cases pelvic contraction.”

³ Spiegelberg; *op. cit.*

⁴ Simpson's *Obstetric Works*.

Schuchard¹ there are 13 cases of this accident in 73 cases of hydrocephalus.

The accident has occurred much more frequently in multiparæ than in primiparæ, only 12 per cent., according to Baudl, of the latter being found among the entire number. That primiparity protects against, and multiparity predisposes to, uterine rupture has received different explanations. The one most generally accepted is that repeated pregnancies lead to thinning or weakening of the walls of the uterus. But, according to Spiegelberg, the cervix furnishes greater resistance in the primiparæ, also the os internum is not so quickly drawn above the child, while the connections of the uterus with the pelvis are stronger; the greater force of abdominal pressure pushes the uterus against the latter. In multiparæ, lateral, and especially anterior, deviation of the uterus is frequent, and hence excessive stretching of the neck on one side is frequent. Zweifel states that the lessened elasticity and contractility of the uterus is the chief cause of the greater liability in old primiparæ to rupture, but that it is probable lessened abdominal pressure is also a cause. Nevertheless, it seems to me that two of the most important causes have been omitted. One of these is the much greater frequency of a shoulder presentation in multiparæ than in primiparæ, such malpresentation occurring in only 12 per cent. of the latter, according to the statistics of the Berlin clinic, and in only 6 per cent., according to those of Spiegelberg's clinic. The other is the progressive increase in the size of the children in successive pregnancies. It is possible that hydrocephalus is much more frequent toward the close of the childbearing period: statistics are wanting to prove this point, but should it be established there would be an additional reason for the greater frequency of the accident in multiparæ than in primiparæ.

Degree, Direction, and Complications of Uterine Ruptures.—The tear may be complete or incomplete; the latter involves only the muscular wall, the peritoneal coat remaining entire, but underneath this covering there is usually extravasated blood; so too, especially if there be entrance of air into the uterine cavity, by the introduction of the hand, as for turning or for the application of the forceps, subperitoneal emphysema may occur. If the peritoneum is not torn, there is no hemorrhage into the abdominal cavity, but there may be grave hemorrhage external to it. Goodfellow² has reported an instance of rupture of the uterus, the woman dying on the third day, and the autopsy showed a transverse rupture of the cervical portion of the uterus on the right side above the utero-vaginal junction, and a considerable

¹ "Ueber die Schwierigkeit der Diagnose und die Häufigkeit der Uterusruptur bei fötaler Hydrocephalie," *University of Berlin Thesis*, 1884.

² *Am. Journ. of Obstet.*, 1884.

hemorrhage in the connective tissue of that side extending into the iliac region beneath the peritoneum: "there was no blood in the abdominal cavity, and the peritoneum was not torn." The woman, was at the beginning of the eighth month of pregnancy when taken in labor; she died after three days, and at the autopsy there was found a rent in the fundus of the uterus through which the ovum had entered the abdominal cavity.

It is stated that in some very rare cases the peritoneum alone is torn, but such an accident cannot by any means approach the gravity of what is generally known as rupture of the uterus.

Uterine ruptures are generally quite extensive, often permitting the escape of the entire foetus or a part of it into the abdominal cavity. The rent in at least one instance was so large that the entire ovum entered the abdominal cavity. This case was reported by Salin¹ of Stockholm. Uterine ruptures may be complicated by tears of the vagina, even of the rectum or of the bladder, and by the prolapse of intestines through the rent.

SYMPTOMS AND FATALITY.—In many cases during a pain of unusual severity or an obstetric manipulation, as the introduction of a blade of forceps or of the hand for performing version, suffering of unusual severity is felt by the patient. She may be, as Trask has stated, conscious of something having given way in her; "she feels a tearing or rending sensation." That there is caused by the tearing a noise heard by those present, although this has been reported in some instances, seems extremely doubtful. The woman's face is pale and covered with a cold sweat; there are nausea and vomiting, and the pulse is irregular, rapid, and thread-like; the respiration is hurried, difficult, and sighing; the vision becomes imperfect, and there is ringing in the ears. In most instances the uterine contractions cease, and upon vaginal examination the presenting part has receded. There is severe pain in the abdomen, and the latter presents a notable change in form if the foetus has in whole or in part entered its cavity or if there has been great hemorrhage into it. Jolly² in the 580 cases which he has collected found the following symptoms:

Abrupt cessation of contractions was observed in	218 cases.
Gradual " " " " " "	38 "
Change in the pulse " " " " " "	179 "
Prostration " " " " " "	151 "
External hemorrhage, slight in 33, " " " " " "	148 "
Retrocession of the presenting part was " " " " " "	146 "
Abdominal pain " " " " " "	115 "
Alteration of countenance " " " " " "	115 "
Foetal parts felt immediately under abdominal wall in	77 "
Acute pain at the moment of rupture in	62 "

¹ *Centralb. für Gyn.*, 1882.

² *Paris Thesis*, 1870.

Hemorrhage may be internal or external, or both varieties may occur. In some instances abrupt cessation of the fetal movements, hitherto quite active, has been observed, and there is arrest of the sounds of the fetal heart. Kiwisch, McClintock, Montgomery, Paulty, Ross, Creighton, and Schatz have pointed out as a pathognomonic phenomenon the occurrence of emphysema at the level of the hypogastric region. Trask regarded the diagnostic marks as two—the recession of the presenting part, and the power to distinguish the limbs of the fetus directly beneath the abdominal wall. Jolly found in thirty-seven cases that the uterine contractions did not cease, or only temporarily, and that in some they retained their normal force.

A vaginal examination may not only make known the recession of the presenting part—such recession, however, does not occur if that part has become wedged in the pelvis—and hemorrhage, but also by it the rent may be felt, and possibly through it prolapsed intestine.

Rupture of the uterus is one of the gravest accidents in labor. The child almost inevitably perishes at once, while the mother is in immediate danger from shock and hemorrhage, and in proximate from septic infection. Death may at once follow the accident. Thus, Dr. Churchill¹ states that in a case under his care the woman died in five minutes after the rupture. While Jolly gave the percentage of recoveries as 17, Spiegelberg regarded this as much too high, and considered 5 per cent., the result established by Hugenberger, as being near the truth. So, too, Zweifel after quoting Trask as deriving from his statistics that the mortality of expectant treatment was 78 per cent., after delivery by the vagina 68 per cent., and after laparotomy 24 per cent., says these statistics cannot be correct. The surprisingly small mortality when laparotomy was done is to be explained by the fact that cases operated upon which recovered are reported, while the others are passed over, and the relative smallness of the figures.

TREATMENT.—This comprises that which is required in threatened rupture and that required after the accident has occurred. In the former immediate delivery is demanded, and this must be effected without additional stretching of the cervix. Hence, embryotomy is preferable to version, for, as observed by Zweifel, the introduction of the hand for the accomplishment of the latter is no less dangerous than turning the child in the uterus closely enclosing it. If the child occupies a transverse position, embryotomy; if the head presents in a contracted pelvis, craniotomy; or if there be hydrocephalus, perforation,—constitute the treatment as briefly advised by Zweifel; and he adds that transverse position, narrow pelvis, and hydrocephalus are almost the sole complications of labor, bringing the imminent danger of rupture of the uterus.

¹ *Theory and Practice of Midwifery*, 6th ed.

After rupture of the uterus, too, delivery must be made as soon as possible. If the woman is greatly prostrated, stimulants—especially a hypodermic of sulphuric ether—are indicated, and other suitable means employed to bring about reaction. The modes by which delivery is to be effected will depend upon the position of the child, the presentation, and the special obstacle to labor which has been the chief cause of the injury. The child is either in the uterus or in the abdominal cavity, or partly in each. In the first case, supposing the head to present, the forceps or the cephalotribe is indicated: of course the head is first opened if the latter instrument is employed. If the head be not accessible, delivery by podalic version is indicated. In the third case, still, delivery through the natural passage is the rule if the part of the fœtus that has entered the abdomen can be easily brought into the uterine cavity and without increasing the rent. But if such restoration is impossible without this additional injury to the uterus, and in the second condition that has been stated, abdominal section is required. After delivery through the natural passage, a 2 per cent. solution of carbolic acid is used to thoroughly wash out the cavity, and a drainage-tube introduced. Frommel,¹ pursuing this method, had in 1880 three successful cases, and the next year Hecker² reported a success obtained in like manner. Schlemer³ in 1882 reported a case of rupture in which a portion of intestine prolapsed through the rent, the fact of the rent and of the prolapse being ascertained after delivery with the forceps; the bowel was restored, a drainage-tube introduced, an injection of carbolized water employed; the injection was repeated daily, and the woman recovered.

Associated with drainage a compressive abdominal bandage is employed. The drainage-tube is of glass, and is T-shaped; injections are, as a rule, not made through it into the abdominal cavity, but the nozzle of a syringe may from time to time be introduced into the tube, and fluid drawn out: the tube is removed in about a week. Zweifel, after stating that Schroeder, Frommel, Gräfe, Hecker, and Morsbach have had excellent results from this treatment, adds that he has also had in his clinic a case that was successful by means of peritoneal drainage.

In a case of rupture⁴ reported by Rhinestädter the peritoneal cavity was washed out through the drainage-tube with a 1 per cent. carbolic-acid solution, an antiseptic vaginal tampon introduced, and an ice-bladder applied to the abdomen over the rupture. The vaginal dressing was renewed the next day, the drainage-tube was removed four weeks after the delivery; the woman recovered.

Zweifel⁵ rests the decision as to extirpating the uterus after abdominal section upon its contracting well or failing to contract, for in the

¹ "Zur Therapie der Uterusruptur," *Centralblatt für Gynäkol.*, 1880.

² *Ibid.*, 1881.

³ *Ibid.*, 1882.

⁴ *Op. cit.*

⁵ See Kormann: *op. cit.*

latter case the consequent danger of hemorrhage into the abdominal cavity is so great that the removal of the organ is advisable.

INJURIES OF THE VAGINA.

It is proposed under this head to consider not only lacerations, but also contused and perforating wounds of the vagina received in labor.

It is convenient, as Spiegelberg¹ has done, to divide tears and other injuries of the vagina into those of the upper, of the middle, and of the lower part of the vagina. Vaginal tears are frequently associated with corresponding injuries of the uterine. Nevertheless, McClintock,² from the statistics of the Rotunda Lying-in Hospital, found 35 of 108 which involved the vagina only, or merely the os uteri with it; it is thus seen that the cases of vaginal injury are a little more than one-third of the entire number. Spontaneous tears of the vaginal vault are more frequently transverse than longitudinal, while those in the middle portion of the vagina are generally longitudinal. In some instances the vagina has been by a circular rent partially, or even completely, separated from the uterus. Johnson and Sinclair³ give the case of a patient in whom a fatal injury of this kind occurred: the woman was a multipara, but delivery being impossible because of cicatrices in the lower part of the vagina even after division of the cicatricial tissue was made with a bistoury, craniotomy was performed: death occurred the next day. An instance of perforation of the posterior cul-de-sac by a vaginal douche, used to induce labor at the eighth month of pregnancy because of pelvic deformity, is given by Budin.⁴ So, too, the vaginal vault has been torn by the badly-directed blade of forceps or cephalotribe. Both spontaneous and artificial rents of the upper posterior portion of the vagina are especially liable to occur in case there be a pendulous abdomen permitting anterior displacement of the uterus, for by this displacement the tissues are stretched and thinned. Hart⁵ has shown that the posterior vaginal wall is structurally weak at its upper half inch, while it is more elongated than the anterior wall in labor. Rupture is most common where the posterior vaginal wall is covered by peritoneum, and when it occurs is a tension tear like cervical rupture. Instances of injury to the vagina anteriorly and posteriorly have occurred from the use of the perforator: in one case⁶ the practitioner, wishing to open the child's head, made a rent in the bladder, permitting the introduction of three fingers, and in another case,⁷ the obstet-

¹ *Op. cit.*

² *Dublin Journal of Medical Science*, May, 1866.

³ *Midwifery*.

⁴ *Des Lésions traumatiques chez la Femme dans les Accouchements artificiels*, par Pierre Budin, Paris, 1878.

⁵ *Trans. Edinb. Obstet. Soc.*, vol. viii.

⁶ *Provincial Medical Journal*, 1843.

⁷ Budin: *op. cit.*

rician, attempting the same operation, thrust his instrument through the tissues, and applied it to the sacral promontory, mistaking it for the foetal head. Rupture of the vaginal vault has been caused by forcible introduction of the hand into the uterus for the purpose of performing version.¹

Prolapse of the intestine through the rent has been observed in several cases. Danyau² in 1850 collected 17 cases of rupture of the vagina in which the foetus passed into the abdominal cavity: 4 of these patients recovered. Others too have recovered, though the injury permitted prolapse of the intestine. Moysant has reported a case in which a woman being in labor the forceps was vainly applied, and then delivery by podalic version tried; the trunk was extracted, but the head left behind; the woman died in a few hours, and at the post-mortem the foetal head was found in the left side of the abdominal cavity, having entered through a rent which extended from the uterine junction to the vulva.

McClintock³ gives as the cause of spontaneous rupture of the vagina in the cases which he collected—1, diseases of the vagina; 2, disproportion between the size of the foetal head and the maternal pelvis; and 3, osseous irregularity upon the inner surface of the pelvis. While, according to the same authority, the recoveries after uterine rupture are only $4\frac{1}{2}$ per cent., they are after similar injury to the vagina 12 per cent.

The SYMPTOMS that have been most frequently observed in ruptures of the vagina are cessation of labor-pains, hemorrhage, recession of the presenting part, which, however, is slight unless the foetus enters the abdominal cavity: prolapse of intestine or of omentum is a not infrequent complication. Shock too has been observed in many cases.

TREATMENT.—The treatment is very similar to that required in similar injury to the uterus. Prompt delivery is indicated, and usually this will be made through the vagina; arrest of bleeding will be accomplished by hot-water injections, by sutures, and in only exceptional cases will a styptic tampon be employed; a lateral rent or one involving the peritoneum will usually require a drainage-tube: of course antiseptics will be used in the immediate and in the subsequent treatment.

Rents of the Middle Portion of the Vagina.—These are usually superficial: they may be caused by careless use of the perforator or of the crotchet, or the vagina may be torn by sharp fragments of bones of the foetal head in extraction after craniotomy. Injury may be done in the introduction of the blade of the forceps, this being forced instead of caused gently “to feel” its way to the desired point; so too

¹ Spiegelberg: *op. cit.*, *Bulletins de la Société anatomique*, 1857.

² *Arch. méd.*

³ *Op. cit.*

injury may be done in the extraction, especially in case the blades are not accurately applied to the sides of the child's head and kept in such close relation, for the fetal head ought to be a protection to the vagina from injury by the borders or by the ends of the forceps blades. Deep tears of the middle portion of the vagina may occur if there be structural change in its tissues, whether from malignant disease or from cicatricial contraction. Contused wounds of the vagina most frequently result from prolonged impaction of the head in the pelvic cavity—and as a consequence subsequent sloughing occurs—which if they involve the anterior wall of the vagina result in a vesico-vaginal fistula, or if the posterior a recto-vaginal fistula.

TREATMENT.—It rarely happens that bleeding from wounds of the middle portion of the vagina is considerable, and its treatment does not differ from that required in similar injury of the upper portion. The most important part of the treatment of the colpitis resulting from the injury will be the use of warm antiseptic injections—1 part of corrosive sublimate to 4000 of water, for example—and following the injection by introducing an iodoform suppository: if a contused wound involving the anterior wall be present, great care must be taken to prevent distension of the bladder; after sloughing of any part of the vaginal walls means must be used during the healing to prevent contractions, metal, glass, or hard-rubber dilators being introduced from time to time.

As showing the greater liability to injuries to the vagina in birth in case the child be male, the fact stated by Spiegelberg is significant: thus in 12 cases of vesico-vaginal fistula at his clinic and polyclinic, all the children were boys.

Tears of the Lower Portion of the Vagina.—Though these are in most cases associated with corresponding injuries to the perineum or vulva, yet some are not, and therefore should be considered separately. So far as spontaneous injuries of this class are concerned, their most frequent cause is excessive stretching of the vagina; they are usually superficial and situated at or near the median line; in some cases, however, they may have a diagonal course, or two diagonal tears may be united with a median tear having approximately the form of a Y. Contused wounds resulting from prolonged pressure by the presenting part are also found here, and they may be followed by sloughing, which may end in rectal or in perineal perforation. Improper use of the forceps is to be credited with many injuries to the lower part of the vagina: these injuries may result from too rapid extraction, but probably their most frequent cause is turning the handles of the forceps too soon toward the abdomen of the mother, and thus the points of the blades are withdrawn from the child's head and brought directly against the posterior wall of the vagina, making more or less deep furrows in

its tissues : a similar accident has occurred from the attempt to withdraw the blades just before the expulsion of the head, a violent pain suddenly expelling the head, while the obstetrician, busy with the manœuvre mentioned, was powerless to prevent the rapid delivery. Dupuy¹ mentions a case in which, the feet presenting, one of these escaped by the vulvar opening, while the other, pressing strongly upon the vagina posteriorly, was forced through the perineum. I have seen a somewhat similar case, only the foot inflicting the injury made a rent at the lower portion of the recto-vaginal wall and protruded through the anus, there being also a slight tear in the posterior perineum. Dr. Barker² has published a case to which he was called where he found the perineum "enormously distended by the pressure of the head, and the left hand and forearm projecting through the anus." He did not attempt to restore the member, but delivered with the forceps. The patient's bowels were kept confined by opium for ten days, and complete cicatrization followed.

TREATMENT.—Bleeding from uncomplicated lacerations of the lower part of the vagina is usually only slight, and therefore can only exceptionally require means for its arrest. While, too, in most cases these tears are only superficial, and therefore require no treatment other than cleanliness and the use of antiseptic applications, in others their extent is such that not only to protect from septic infection and to secure their rapid healing, but also to guard against possibly permanent injury to the pelvic floor, sutures are plainly indicated. Properly prepared cat-gut is the best material for stitching the surfaces together, and the continuous suture may then be employed.

INJURIES OF THE VULVA AND OF THE PERINEUM.

The vaginal canal does not open immediately externally, but through the canal of the vulva, and during the expulsion of the foetal head the latter becomes greatly increased, partly at the expense of the labia and adjacent external tissues, and partly by the stretched anterior portion of the perineum : the resisting vulvar ring has the fourchette posteriorly, the nymphæ and the greater lips at the sides, and the inferior margin of the vestibule above or anteriorly. Any part of this ring may be torn, and some part of it, generally the fourchette, is torn in the primipara ; it is not uncommon for the rent to begin in the lower portion of the vagina—that is, at the true vaginal orifice—and thence extend to the vulva. Budin³ from his own observations was led to remark : "Thus, then, it is the resistance of the vaginal orifice, hyme-

¹ *Considérations relatives aux Déchirures du Vagin à la Suite de l'Accouchement*, Paris, 1822.

² *The Puerperal Diseases*, p. 42.

³ *Obstétrique et Gynécologie*.

neal orifice, which in primipare renders the period of expulsion so long: it may be said that in them the fœtal head must successively escape three orifices—viz. the uterine, the vaginal, and the vulvar—and the resistance offered by the vaginal orifice is not the least.” J. Matthews Duncan¹ refers to laceration of the vaginal orifice as frequently the first step to laceration of the fourchette or of the perineum more extensively, and regards this posterior laceration as inevitable.

Lateral tears involving one or the other nymphæ may occur: in some instances one of these may be divided in the median line, while in others there is partial separation of the base; or the tear may extend from the inferior margin of the vestibule backward by the side of the urethra or upward through the tissue of the vestibule to the clitoris, and if the laceration is deep the corpus cavernosum of this organ upon one side may be torn: in case of a deep tear, very considerable hemorrhage generally follows. Young² has narrated two cases of hemorrhage caused by a wound of the vestibule in labor, one of which was fatal, seen by him. In the patient that died he found a distinct tear five-eighths of an inch long extending from the left side of the urethra upward to the left of the clitoris. The bottom of the wound, which was about seven-eighths of an inch deep, presented a spongy appearance, the spaces of which communicated freely with each other and the underlying veins. In the second patient the hemorrhage was so great as to cause faintness: Young found that the flow was from a tear about one and a half inches long, running from the neighborhood of the clitoris, on the left side, downward toward the urethra. Pressure with the finger for five minutes stopped the hemorrhage, and to prevent its recurrence the wound was closed with two metallic sutures.

In regard to tearing of one of the nymphæ, Duncan describes it as beginning in the vaginal orifice, and at its side anteriorly, where the parietal protuberance has pressed, and states that this tear may bleed freely: the left side is more frequently the seat of tearing than the right.

Budin,³ in a note upon a sign permitting the recognition of a hemorrhage from the walls of the vulva or of the vagina after delivery, remarks: “If the blood comes from the clitoris, it flows immediately externally as soon as the head has escaped, even before the expulsion of the trunk. If, on the contrary, it comes from rupture of the neck of the womb, it is doubtless effaced by the friction of the body of the fœtus against the greatly-distended vaginal walls. We ask, then, If it would not be more rational to conclude from the presence of a large stain of blood extending over the shoulder and the trunk that there was rupture of a vessel occupying the anterior part of the vagina?”

TREATMENT OF TEARS OF THE VULVA.—Tears of the fourchette,

¹ “Papers on the Female Perineum.”

² *Transactions of the Edinburgh Obstetrical Society*, vol. viii.

³ *Op. cit.*

unless extending into the perineum, do not require special attention. In lateral tears we lessen the liability to septic infection and arrest hemorrhage by sutures, the material being preferably catgut. If a tear in the vestibule bleeds much, the hemorrhage can generally be stopped by compression, but, as a rule, one or two deep stitches are to be preferred.

INJURIES OF THE PERINEUM.

These may be divided into contusions, perforations, and tears. Violent or prolonged pressure of the child's head upon the perineum may produce more or less bruising of the tissues, and from such contusion sloughing occur, so that a perineum which was entire when labor ended may some days afterward appear as if a tear had occurred during labor. Dewees¹ has narrated a case in his practice of a primipara in whom the head remained pressing upon the perineum for four hours because of her unwillingness to have forceps used; she then consented, and was delivered in fifteen minutes of a living child. "About the eighth day sloughing of the perineum commenced, and proceeded down to the sphincter ani and some distance up the vagina. The parts have healed, however, more fortunately than could at first have been expected, the perineum almost alone having suffered, leaving the rectum safe and the vagina without serious injury: the case now resembles a lacerated perineum." Cases of similar injury have been reported by Duncan² and by Hibberd.³ Unjust reproach may be cast upon the obstetrician in whose practice such an accident follows labor, for a perineum the integrity of which seems complete immediately after delivery may several days or weeks later present the characteristics of more or less extensive laceration: the woman, being informed of the present condition by another practitioner, is very apt to blame her former attendant, even though the present one is wise and honest enough to refrain this suggestion.

There are no special directions as to the treatment of these lesions; their prevention will be chiefly accomplished by artificial delivery made before such injurious distension or prolonged pressure occurs.

Perforation or central rupture of the perineum, permitting the escape of the fœtus through this artificial opening, the anal and the vulvar ring remaining complete, has been observed in rare instances. Among the first cases reported were one by Nédey, 1778; Coutouly, 1788; Meckel, 1811; John Douglas of Dublin, 1822; and Merriman, 1826. It was the subject of a clinical lecture by Dupuytren;⁴ and in that

¹ *System of Midwifery*, 8th ed., p. 287, 1837.

² "Papers on the Female Perineum."

³ *American Practitioner*, 1881.

⁴ *Leçons orales de Clinique chirurgicale*, tome troisième, Paris, 1833, p. 168.

lecture there are given the following causes of the accident : The orifice of the vulva being placed high up toward the pubes, while the perineum presents from before backward a great extent, or, if the woman is lying horizontally, a considerable height. The vulvar orifice is in such a subject much lessened, this diminution being consequent upon a sort of prolongation of the perineum which occludes inferiorly a fourth, a third, or even half, of the opening. This vice of conformation may be congenital or accidental—in the latter case from reunion of the soft parts following a burn, for example. Another cause is the sitting position during labor : he states that this was the fact in Nédey's case, and that his own patient was so propped up by pillows as to be almost sitting. The importance of these two causes, thus presented by one of the greatest of French surgeons, is obvious. Remembering that in labor the presenting part first descends to the pelvic floor in very nearly a straight line, and then, in completing the passage through the birth-canal, turns in a direction almost at a right angle to that line which it has hitherto pursued, it can be readily seen that by the prolongation of the perineum toward the pubis and the lessened vulvar orifice, the second line, or axis of the canal, makes a more or less acute angle with the first. The presenting part—the head, for example—is placed at the bottom of a purse. The driving force of uterine and abdominal contractions does not meet with sufficient resistance from the perineum to develop a resultant force able to lift the head up from this depth. The difficulty must obviously be increased if the woman occupies a sitting position.

Now, while in the majority of cases the penetration of the perineum at its thinnest part is followed by a tear extending anteriorly through the vulvar ring or posteriorly through the anal, in rare instances these rings remain entire and the fœtus is transmitted through the artificial ring. In order to understand the possibility of such transmission we must remember not only that the perineum is greatly elongated in labor, so that from measuring only a little more than an inch it may be four or five inches, or even more, but also that the rent is not longitudinal, but, as Dupuytren stated, it may be Y-shaped or it may be stellate, and that the tissues surrounding it are very easily stretched.

A third cause of the accident, stated by Moreau and accepted by Dupuytren, is too great curvature posteriorly of the inferior extremity of the sacrum and of the coccyx, or, which is the same thing, too great prominence of the sacro-vertebral angle.

Charpentier¹ has collected 48 cases of central rupture of the perineum, and in discussing the causes of this accident regarded the following three points as important : 1. The exaggerated height of the pubic

¹ *Archives de Tocologie*, 1885.

symphysis, and the more or less faulty direction of the vulva resulting therefrom; 2, the particular state of the perineum—form, constitution, and extensibility; 3, the excessive intensity and irregularity of the uterine contractions.

The prevention of this accident is to be sought by having the woman lie upon the side, and by directing the head of the fœtus forward to the vulvar ring; further, if that ring, whether from congenital formation or as a consequence of cicatricial contraction, be too small and too undilatable to permit the passage of the foetal head, episiotomy is clearly indicated. Again, if a central tear in the perineum has begun, the obstetrician, bearing in mind the possibility of its extending backward, that more or less damage will be done the anus and rectum should the head pass through the rent, is justifiable in dividing the vulvar ring rather than risk the accident just mentioned, for an anterior opening is preferable to a posterior one. If the labor is over, the child having passed through the artificial opening, closure of that opening by sutures is indicated. Sir James Y. Simpson¹ has reported a case of perineal fistula left by the transit of the infant through the perineum, and has adduced two similar cases previously reported. At the conclusion of his paper he remarks: "To the preceding remarks let me merely add that, as a means of preventing central perineal laceration, and the chance, consequently, of perineal fistula as a result, we have to trust to—1st, the common methodic manual support of the perineum, so as to save excess of pressure upon it, while at the same time we push the head forward to the vaginal opening—a means which, in the practice of Denman and Lachapelle, succeeded in preventing the head from passing through the perineum after its central structures were split and burst; 2d, delivery of the head and its proper guidance through the vulva by the forceps, as has been effected by D'Outrepoint, Hüter, and Brann in cases in which this accident was impending; and, 3d, lateral incisions, if absolutely necessary, of the anterior edge of the perineum, for in this, as in the more common longitudinal forms of ruptured perineum, it is, I believe, better practice to make one or two slight cuts on either side of the fourchette, so as to regulate the site and the direction of the lacerations that must occur, rather than leave their form and character to mere chance alone. It is always an infinitely more important matter to save the sphincter of the anus than the sphincter of the vagina."

Charpentier² has collected several cases in which the arm, descending by the side of the head, has perforated the perineum; also one case in which the lesion was caused by the elbow.

¹ *Obstetric Memoirs and Contributions*, edited by Drs. Priestley and Storer, Philadelphia, 1856.

² *Op. cit.*

TEARS OF THE PERINEUM.—These are incomplete or complete. There are two varieties of the former: in the first of these the tear or fissure is of the mucous or of the cutaneous surface, while in the second both surfaces and the intervening tissues are involved. Further, perineal lacerations may be complicated with corresponding injuries of adjacent parts.

Tears of the perineum are not uncommon; indeed, they are frequent in primiparæ, and even multiparæ by no means always escape. In regard to the percentage of women who suffer from these injuries in childbirth, statistics of different observers so greatly vary¹ that it is unnecessary to quote them as conclusive, because such discrepancies can only be reconciled by supposing that there have been different methods of observation and different criteria of a perineal rent. There is one point, however, upon which statistics agree, and that is that these injuries are much more frequent in cases of delivery with the forceps. Nevertheless, let not the conclusion from this fact be that the instrument itself, by increase of the head circumference, causes the accident. The tear may come from the careless or hurried extraction, or from the resistance of a rigid perineum or of the vaginal or vulvar opening—a resistance which Nature's forces were unable to overcome. If a skilful hand holds the forceps, and tissues and time permit delay until sufficient dilatation or dilatability is secured, no perineum would suffer injury from the forceps which would not have occurred had the delivery been spontaneous; nay, more, the forceps properly used would preserve many a perineum from rupture.

Abnormal position of the vulvar orifice predisposes to perineal tears; so too if this orifice is undilatable or unusually small such accident is inevitable unless means of prevention are used. As Pajot has said, some perineums are destined to tear, and this depends upon the nature and quality of the tissue.² Whenever the labor occurs so rapidly that time is not given for the physiological softening and stretching of the

¹ The following passage is taken from Marduel, vol. xxvi., *Nouveau Dictionnaire de Médecine et de Chirurgie pratiques*: "Without referring to tears of the fourchette, which are almost the rule in primiparæ, and which Schroeder has found in his *accouchées* in the proportion of 61 per 100, we find the basis of the frequency of true tears of the perineum in German and English authors. Thus, Schroeder found these rents in 34½ per cent. of primiparæ, in 9 per cent. of multiparæ; Winckel saw 115 ruptures of the perineum in 1011 deliveries; Olshausen found 21 per cent. in primiparæ, 4.7 per cent. in multiparæ; Hildebrandt gives 7½ per cent.; Hecker, 3.66 per cent. for the Munich clinic." The author states that in more than 300 deliveries in the Lyons clinic he has not seen a single rupture of the perineum. Spiegelberg (*op. cit.*) has stated that of 3000 deliveries in his clinic, there were 102 cases, or 3.5 per cent., in which there was a tear from the fourchette more than 2.5 centimeters long.

² Hecker, who gave the general proportion of women who suffered from perineal tears as 3.66 per cent., found that in primiparæ from thirty to forty-five years of age the proportion was 14 per cent.

tissues which furnish the final barrier to the escape of the fœtus, the integrity of the perineum is imperilled. "In those cases where the infant advances with extreme rapidity from the superior strait to the vulva, in accouchements made precipitate by excessive activity of the uterus, in labors ended by operative intervention, the perineal floor, insufficiently prepared, not having acquired its complete extensibility, runs the risk of being ruptured."¹

Certain presentations and positions create a liability to perineal tears; for example, presentation of the brow or unreduced occipito-posterior position. Excessive development of the fœtus or of part of it, whether physiological or pathological, may cause the injury; thus, in great size of the head or of the shoulders, or if there be hydrocephalus or ascites, or if the abdomen be enlarged from other cause, the perineum may be torn.

The perineum is most liable to be torn in its median line, because there the parts are thinnest in the distension occurring in labor, and farthest from the points of attachment.

While probably few obstetricians study immediately after labor injuries to the mucous surface of the perineum, the gynecologist meets with frequent examples of fissures thus caused, the cutaneous surface being quite normal. Duncan, who has given special study to this subject, states that he has seen no primipara without any injury, and none without a laceration posteriorly of the proper orifice of the vagina as distinguished from a laceration of the fourchette—that is, of the proper vulvar orifice. The fissures observed by the gynecologist upon the lower part of the vagina posteriorly are generally in the median line, though a tear having the form of a V or of a Y may be met with; while usually superficial, in some instances they are so deep that nothing of the perineum is left at this part but the skin. Again, there may be fissures upon the cutaneous surface formed when the perineum is greatly distended, the parts beneath the skin suffering no perceptible injury. Duncan,² who describes as partial central rupture of the perineum a split, crack, or tear of the skin of the perineum, also states that the injury may affect the vagina only; or it may affect the tissues between the vagina and the perineal skin, these two parts remaining entire; or, finally, it may affect skin and mucous membrane and the tissues immediately adjacent, while there remains entire some tissue intervening between the skin and the vagina.

When all the tissues of the perineum are torn, from the vulvar orifice to the anal sphincter, the laceration usually receives the designation of incomplete, and different degrees of such incomplete laceration have been distinguished and described; but such discrimination is not now necessary. If the injury should also include the anal ring, the rupture

¹ Marduel.

² *Op. cit.*

is called complete. The designation of complicated may be given to a rupture that extends above the rectal boundary of the perineum, thus involving more or less of the recto-vaginal wall; or there may be other vaginal rents, as in the case¹ reported by Gervis—an occipito-posterior position, delivery with the forceps; not only the perineum torn, but also a rent of the right lateral vaginal wall extending to the ischio-rectal fossa.

PROPHYLACTIC TREATMENT.—Saving the perineum from injury in childbirth has been the effort of obstetricians for ages, and from time to time different means have been employed or proposed for this purpose: the very multiplicity of means proves their futility in some cases; no universal prophylactic means has yet been found. The student of the history of these various means grows weary of vain repetitions² and of rediscoveries, and of the revival of plans that have been buried so many years, or even centuries, that they have been forgotten: here, as elsewhere in medicine, it may happen that the inventor devises that which was suggested and tried long ago, and he unconsciously repeats the thoughts and renews the methods of those who were dead before he

¹ *St. Thomas' Hospital Reports*, 1874.

² This criticism, however, does not apply to the plan proposed by Dr. D. Berry Hart (*Transactions of the Edinburgh Obstetrical Society*, vol. xii., 1887). Dr. Hart asserts that the term "extension of the head," as the fourth consecutive movement of the labor mechanism, is a most misleading one, for it implies that the chin leaves the sternum while passing the perineum, and that during the anterior fixation of the occiput under the pubic arch antero-posterior and increasing diameters of the fetal head form the antero-posterior diameters of the girdle of resistance. "I deny *in toto* that the chin leaves the sternum, and I hold that this fixation of the occiput and descent of the sinciput is not the best or normal mechanism. The best mechanism to avoid tear is for the occiput to lead, for the head to be driven on by a steady movement of translation, any rotation upon a biparietal axis so taking place as to favor occipital dipping and never dipping of the sinciput. It is easy to see how the erroneous idea of extension arose. The attendant while the patient lay on her left side watched the passage of the fetal head from behind, saw more of the anterior portions of the head appear, and accounted for it by extension."

The following are Dr. Hart's directions for preventing tearing of the perineum: "With the patient lying, of course, on her left side, the attendant places the thumb of his right hand, guarded by a napkin soaked in hot sublimate, in front of the anus, and presses it gently there. The pressure is not in the direction of a line joining his thumb and the pubic arch, but nearly in the axis of the pelvic outlet. By this descent of the sinciput is hindered and that of the occiput favored. When the latter is beginning to pass under the pubic arch the fingers of the same hand are placed between it and the apex of the arch, so that when the occiput has cleared the arch the fingers are passed toward the nape of the neck, and the head thus grasped in the hand, the thumb lying over the sagittal suture. This gives one complete command over the head, which is now engaging in the diameters between the nape of the neck and forehead and face, and allows the whole passage with as little tear as possible."

Accepting Dr. Hart's teaching as to the mechanism of the escape of the fetal head from the final boundary of the birth-canal, we have not only an important guide to the management of spontaneous, but of artificial—with the forceps—delivery of the fetal head, so as to best protect the perineum from injury.

was born. He is fortunate if he does not reinvent that which is only a few years old.

But are we powerless in the presence of the possibility of this accident, which is never so trivial that its prevention is a matter of indifference, and may be so grave that it brings immediate peril and may result in permanent distress? Knowing from the statistics of Schroeder and others that perineal laceration occurs more frequently if a woman be delivered upon her back than if she be upon her side, the obstetrician insists upon her occupying the latter position. Knowing, further, that rapid delivery, more especially in the primipara, is a frequent cause, he delays¹ the expulsion of the child until the parts of the lower portion of the birth-canal, having undergone their physiological softening and stretching, heretofore mentioned, have become dilatable. He corrects, if possible, a brow presentation or an occipito-posterior position. A hydrocephalic head should be punctured, and even, the child being dead, its head or trunk ought also to be lessened in size if the perineum is liable to tear, in order that delivery may occur: better mutilation of a dead child than a serious tear of the perineum of a living mother. Yet cases do occur in which the vulvar ring dilates to a certain degree, and then the process ceases before the dilatation is sufficient for birth; here the remedy is episiotomy: the cases are rare that require this operation, but every practitioner of a few years' experience has met with them.

But notwithstanding all prophylactic means, there are cases in which the perineum must tear, will tear, the tissues giving way under a moderate strain almost as readily as a piece of wet blotting-paper, especially if they have been subjected to continued pressure. Fortunately, however, such cases are quite exceptional.

TREATMENT OF ACTUAL TEARS.—In case of central perforation, the head partially making its way through the rent, division of the anterior bridge is at once indicated, as has been before stated, thus converting the exceptional into the ordinary injury. This conversion may occur spontaneously, but, on the other hand, there is the risk of a tear through the posterior bridge—that is, through the anal ring—which would be a greater misfortune. After the labor is over closure of perineal wounds, except superficial ones, is clearly indicated: an exception may be made if the tissues have been greatly bruised and sloughing is probable. The material for sutures may be of catgut, silkworm gut, silver wire, silk, or of horsehair. If internal stitches are necessary, whether at the vaginal or the rectal surface, or at both,

¹ This delay may be effected by direct pressure of hand or fingers upon the foetal head, or it may be restrained with the forceps; by controlling voluntary efforts of the parturient by direct command or by the administration of chloroform by inhalation, and such inhalation may lessen uterine action also.

catgut is to be preferred and the continuous suture is best. My own preference is for silkworm gut for the external sutures. The woman lies upon her back, the lower limbs strongly flexed; the parts are thoroughly cleansed by a hot antiseptic solution, and a sponge is passed into the vagina above the rent, so as to absorb the uterine flow and prevent its obscuring the parts to be stitched: hemorrhage from the wounded perineum is in some instances so great that ligation of one or more bleeding vessels is necessary. Such great bleeding occurred in three cases after episiotomy had been performed by Depaul, and in one of these a ligature was required for its arrest. Before introducing the stitches the obstetrician cuts off with seissors any loose pieces of tissue, and thus prepares the surfaces of the wound for being brought in accurate apposition. The stitches having been introduced and tied, the vaginal sponge is removed, and the parts again cleansed with an antiseptic solution, iodoform sprinkled upon the external surface of the perineum, and a suppository of iodoform introduced into vagina; the patient is allowed to lie in such position as is most comfortable, and the knees are not bandaged together. For many years I have protested against this confinement of the lower limbs after perineorrhaphy or perineoplasty as an unnecessary cruelty, and as tending, in case of the former rendered necessary by childbirth, to imprison the lochial discharge; by no probable movements of these limbs can the patient put any strain upon the parts that have been stitched together. As to evacuations from the bowels, while some restrain these for a week or ten days, other practitioners prefer to have them occur two or three days after the delivery, and subsequently once in one or two days: the practice of the latter is probably the better. As to the removal of the stitches, of course those of catgut require no attention, for they are absorbed in six to eight days, in some instances unfortunately sooner; sutures of silkworm gut, of silver wire, or of horsehair may be left for ten days or two weeks, or even for a longer period.

In regard to superficial tears, whether of the mucous or of the cutaneous surface of the perineum, the careful and constant use of antiseptic applications during their healing is imperative, and constitutes, in fact, the only treatment required.

INVERSION OF THE UTERUS.

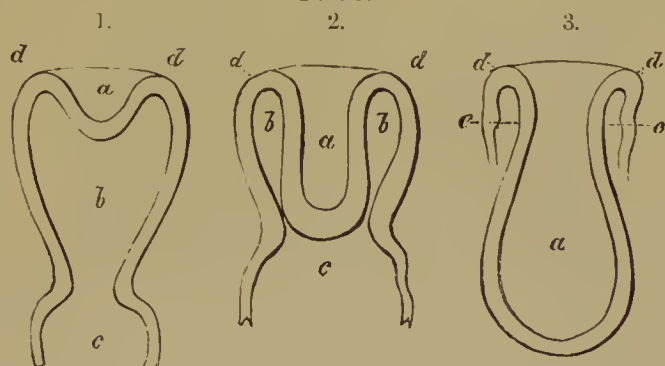
Inversion of the uterus is the gravest displacement of this organ that is possible. Fortunately, it is not a frequent accident, statistics showing that it does not occur oftener than once in one hundred and forty thousand deliveries. An inverted uterus has been compared to the finger of a glove turned inside out, and the disorder has been described as a hernia of the uterus through the os; Paré applied the

term "perversion" to it—a word which Crosse in his well-known monograph¹ used to designate the final degree of this displacement: if the inversion be complete, the simplest statement of the condition is, The uterus is upside down and wrong side out. Denuec² attributes the first recognition of inversion of the uterus to Hippocrates, who also directed a plan for its restoration; he quotes, too, a passage from Aretæus, who not only described the accident, but also referred to traction upon the cord as one of the causes, this traction being made in an effort to remove an attached placenta: so, too, subsequent great lights of ancient medicine, as Soranus, Moschion, Galen, Paul of Ægina, and others, have referred more or less distinctly to inversion of the uterus as an accident of childbirth.

Two conditions of the uterus are necessary in order that it can become inverted—increase of the cavity and relaxation, either general or limited, of the walls. These conditions are presented by the uterus in pregnancy and in labor, but they may also occur if the uterus be distended from other cause than an ovum; as, for example, by a polypus. In 400 cases of this accident collected by Crosse, only 50 occurred independently of pregnancy: most of the 350 thus connected with gestation occurred at its conclusion, only a very few happening after abortion.

In this article the inversion occurring in connection with childbirth will alone be considered, for that variety which is connected with certain intra-uterine tumors belongs to a treatise upon diseases of women:

FIG. 3.



Three Degrees of Inversion; 1, depression; 2, introversion; 3, complete inversion (Crosse): a, fundus of uterus; b, cavity of uteri receiving inverted fundus; c, vagina; d, mouth of inverted portion.

for the same reason the treatment required in acute puerperal inversion will be presented, and that of chronic inversion omitted.

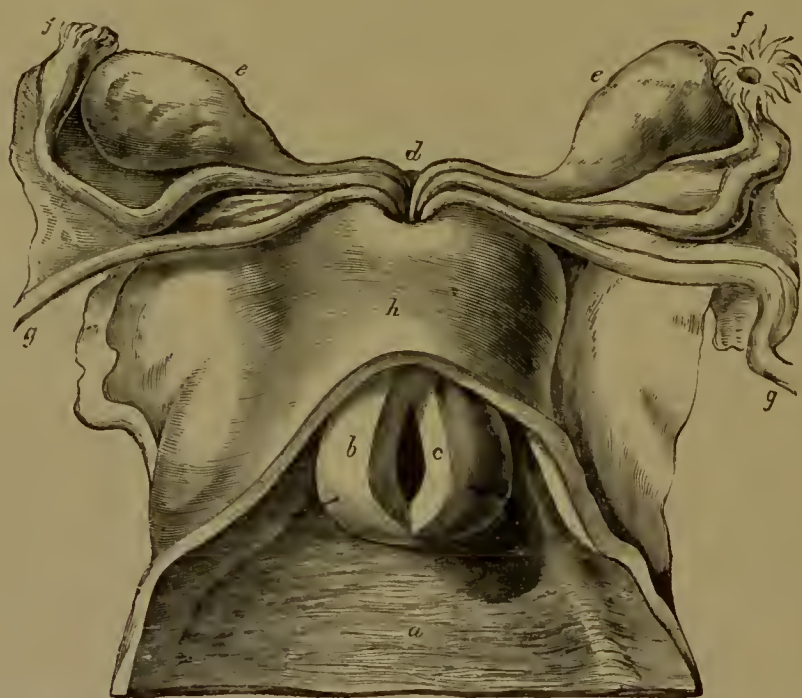
The uterus when inverted forms a cavity lined with serous membrane and opening into the abdomen; according to the degree and

¹ "Essay upon Uterine Inversion," *Transactions of the Provincial Medical and Surgical Association*, London, 1844 and 1847.

² *Traité clinique de l'Inversion utérine*, Paris, 1883.

the recency of the inversion this newly-formed cavity will contain part of the oviducts, of the round and of the broad ligaments, and in some instances the ovaries and loops of intestine. Three degrees of inversion are described. In the first the fundus is depressed, a cup-like cavity being formed which may be felt from the abdominal wall; in the second the fundus has descended to the internal os uteri, the entire body of the organ thus participating in the displacement; in the third degree the fundus and the body have passed out of the os: in the last case the uterus may pass out of the vulva and be external, the vagina necessarily undergoing partial inversion, and then there is prolapse of the inverted uterus.

FIG. 4.



Inversion of Uterus, from specimen in Musée Dupuytren (after Crosse): *a*, vagina; *b*, inverted fundus, incised at *c* to show its cavity; *d*, point of inversion, with round ligaments, tubes, and ovarian ligaments drawn in; *ee*, ovaries; *ff*, fimbriated ends of tubes; *gg*, round ligaments; *h*, cervix covered by peritoneum.

CAUSES OF UTERINE INVERSION.—Remembering that the first degree of this disorder consists in a depression of the uterine wall at its upper portion—a cupping of the fundus, as it is sometimes called—this depression may result from intra-uterine traction or from extra-uterine pressure. Either traction or pressure may be spontaneous or artificial; the resulting inversion may be complete or incomplete.

Pulling upon the cord for the delivery of the placenta was, as has been previously stated, recognized by Aretæus as one of the causes of uterine inversion, and probably it is the most frequent cause. The

scepticism as to this being common manifested by one of the wisest of American gynecologists, Dr. Emmet, upon the ground that such delivery of the placenta is so common on the part of ignorant midwives, and therefore the accident ought to be much more frequent, is not well founded. Certain conditions must be present in order that traction upon the cord may invert the uterus, and among these are a firm attachment of the placenta and uterine relaxation: the usual absence of these conditions explains the rarity of the accident.

One of the most remarkable cases of uterine inversion caused by pulling upon the cord has been recorded¹ by an American physician, Dr. Woodson of Kentucky: A negress four months pregnant was taken with severe uterine pains in a bath; she succeeded in seizing the fetus and dragged it out, inverting the uterus. Relative or absolute shortness of the cord has in several instances been followed in spontaneous delivery by inversion of the uterus: Baudeloeque has given two examples. So also delivery with the forceps has in a similar condition of the cord caused the accident: illustrative cases are given by Levret and Böckendal.² The cord may be normal in length, but from the unusual position occupied by the woman during the expulsion of the child the uterus may be inverted by the weight of the child dragging upon or suspended by the cord. Daillez reported the following case: A girl eighteen years old, near her labor, was driven from home by her father; she took refuge in the house of a friend, and soon felt the pains of childbirth. An accoucheur called to her thought that she was suffering with false pains, and went away; upon his return he found her dying, the uterus completely inverted and hanging between her thighs; he learned that the unfortunate girl was delivered standing, her elbows resting upon the back of a chair; the child suddenly escaped and the cord was ruptured. The traction upon the uterine wall may be made by the partially-detached placenta and clots of blood; thus, Kormann³ quotes a case from Dr. Camillo Fürst in which the accident occurred from the weight of a mass of blood resulting from a partial separation of the placenta retained by adherent membranes.

The inversion may be caused by extra-uterine pressure. This pressure may be manual or abdominal. The former may be made in improper efforts exercised to effect the delivery of the placenta by the so-called Credé's method. But abdominal pressure, there being no manual interference whatever, may cause the accident. Denuce quotes from Galen the following remarkable passage, showing how this great master recognized this cause of uterine inversion: "Under the influence of the power of expulsion, which is the opposite of the power of retention of which we have spoken, the mouth of the womb opens, and the entire

¹ *American Journal of the Medical Sciences*, 1860.

² See Denuce.

³ *Op. cit.*

fundus of this organ so far as possible approaches it, pushing the fœtus out. At the same time as the fundus of the uterus, the parts that surround it, the abdominal walls, which are the external walls of the instrument of expulsion regarded in its whole, pushing by the action of all their forces, strongly clasp the fœtus and force all out. This part of the action, which is under the woman's control, resides not in the uterus, but in the abdominal muscles, which come to her aid as they do in defœcation and in urination. Also in some women, when this expulsive power is exerted immoderately, the violent pains may drive out the uterus itself. The accident is entirely similar to that which occurs in a struggle or combat, when one of the contestants, forcing the other backward, throws him upon the ground, at the same time falling on him. Thus the uterus, when it violently expels the fœtus, may itself be at the same time precipitated without, especially if the ligaments which fasten it in the basin are previously relaxed."

Paralysis of the placental site or general atony of the uterus is a condition which permits inversion of the uterus by abdominal pressure. Supposing the portion of the uterus corresponding with the place of placental attachment to be paralyzed, there may follow, either with or without abdominal strain, dropping down of this part into the grasp of non-paralyzed but active muscular walls of the uterus; these, therefore, receiving the introcedent mass actively contracting, may make the inversion complete. John Hunter, in describing an inversion of the uterus caused by a polypus, observed: "I conceive the contained or inverted part becomes an adventitious or extraneous body to the containing, and it continues its action to get rid of the inverted part, similar to an intussusception of the intestine." Barnes, in referring to Hunter's description, states that it contains the germ of most subsequent theoretical explanations.

Professor Isaac E. Taylor holds that sometimes inversion begins at the cervix, this part undergoing eversion as in prolapsus, and this going on to complete inversion of the organ. Dennee considers this prolapse which Taylor refers to as connected with the precise moment of evolution of partial inversion where the uterine depression, forced by uterine or abdominal contractions, escapes the orifice of the neck and is gradually transformed into an incomplete inversion appreciable in the vagina and between the lips of the neck.

Duncan¹ recognizes four kinds of uterine inversion occurring after delivery: 1, spontaneous passive uterine inversion; 2, artificial passive uterine inversion; 3, spontaneous active uterine inversion; and, 4, artificial active uterine inversion. "The only uterine condition essential to the production of all these kinds is paralysis or inertia or complete inaction. This is the condition of the whole organ at the time

¹ *Researches in Obstetrics*, Edinburgh, 1868.

of production of the first two kinds. In the last two kinds it is accompanied by uterine activity, and, as these cannot coexist in the same part, the paralysis is partial and the activity partial. Action of the uterine wall cannot cause introcession of it. Activity of the whole of the uterus renders inversion impossible. Activity of a part of the uterus renders introcession of that part impossible. There must therefore be paralysis of the whole or of a part before inversion can begin."

SYMPTOMS AND DIAGNOSIS.—Pain, shock, and hemorrhage are the chief symptoms of sudden and complete inversion of the uterus. The woman in many cases cries out with the suffering; she declares, if the inversion rapidly occurs as a consequence of traction upon the cord, that her intestines are being torn away. The shock is partly the expression of this acute suffering, partly the sudden withdrawal from the abdomen of one of its largest organs; and should serious hemorrhage occur, the loss of blood contributes to it. The face is pale, the expression anxious, the pulse frequent and feeble, the limbs cool, and there may be vomiting and also convulsions. The hemorrhage may be slight, for if the placenta be entirely adherent to the uterus, there can be no considerable bleeding; if, however, it be completely or partially detached, the flow may be very profuse and prove fatal in a short time. But there may be little or no bleeding, yet the collapse be profound. "Symptoms of incarceration may and frequently do arise when coils of intestine have entered the funnel formed by the inverted uterus and have become compressed."¹

Abdominal examination shows the absence of the uterine globe, and a tumor occupying the vagina, or even chiefly projecting from the vulva, is found. This tumor may have the placenta still attached, and then an error in diagnosis is impossible. If the placenta has been cast off, the obstetrician possibly doubts whether the tumor found in the vagina or at the vulva be an inverted uterus or a polypus, retention of urine being a common consequence of inverted uterus, and a distended bladder may simulate the uterus; therefore, let him who has not witnessed the accident, but who first sees the condition hours or a day or two after its occurrence, begin by using a catheter. No confusion from this cause, and no error in diagnosis thence derived, a bimanual examination, the impossibility of passing a uterine sound into the uterine cavity if the organ be inverted, and ascertaining that the point of a sound passed into the bladder may be felt in the median line by two fingers in the rectum too distinctly to suppose that the uterus intervenes, will leave no doubt in the mind of the careful examiner. I have been called to three cases of inversion of the uterus, and I have not in one of them found the organ the seat of intermittent contractions; yet such contractions have been brought forward as one of the

¹ Kormann.

means by which the inverted uterus can be distinguished from a uterine polypus. So, too, I utterly reject dependence upon the sensitiveness of an inverted uterus as a means of diagnosis: many years ago in a case of doubtful vaginal tumor I held in my hand that which by other means was proved to be the inverted uterus, and, watching the face of the patient, made two or three punctures of the tumor with an exploring-needle, and there was not the slightest shade of suffering passed over her countenance coincidently with a puncture. The two signs that have just been mentioned, though indorsed by high authorities, may possibly in some cases be valuable, but as a rule I believe they will prove doubtful or even deceptive.

In rare instances inversion of the uterus has occurred some days after labor. It is most probable, however, that in such cases there was already an unrecognized partial inversion, beginning at or soon after delivery, which under the influence of contractions was converted into a complete condition.

PROGNOSIS.—Acute puerperal inversion of the uterus is a condition of immediate and great peril. Even though restoration of the organ be promptly accomplished, death may follow, as in a case reported by Breus.¹ Crosse's statistics show that of 109 patients who died, a fatal result occurred in 79 within a few years, in 8 at the end of a week, and in 6 after a month. If the unhappy victim has escaped death from shock or hemorrhage, sloughing of the uterus in consequence of constriction by the neck may bring a fatal issue early in the puerperal period. Spontaneous restoration of an inverted uterus even months or years after the accident has occurred in very rare instances, but the probability of this event is too slight to sustain a rational hope.

TREATMENT.—Immediate restoration of the organ to its normal place is indicated, and the sooner after the accident the effort is made the greater the probability of success. Supposing the placenta to be still attached,² the obstetrician grasps the uterus in his hand—antiseptics being used, and if the patient's condition does not forbid anesthesia is employed—presses the organ upward, being careful to avoid the sacral promontory, and at the same time with the other hand counter-pressure is made through the abdominal wall; and possibly the fingers of this hand may be usefully employed in overcoming the resistance of the

¹ *Wien. med. Woch.*, 1882.

² Obstetricians are not agreed as to whether the placenta should be removed, provided no separation has begun, before restoration of the inverted organ is attempted. The argument in favor of its removal first is that this can be much more readily accomplished before than after the reduction, and that reduction will be more readily accomplished without than with the placenta. The argument against it is that thereby hemorrhage is at once caused; possibly, too, we are less liable to injure the uterine walls by pressure with the cone-formed fingers or with the fist, when these walls are in part protected by the intervening placenta.

entrance to the uterine cavity now opening into the abdomen. The fingers of the hand which holds the uterus may be usefully employed in dilating the ring-like cervix, while the palm presses the uterus against the resisting cervix. It will be observed that in this manipulation the taxis is peripheral, and the effort is made to restore first that part of the uterus which came out last. Another mode of restoration is by pressure directly made upon the fundus: this pressure is usually made by the fingers of one hand brought together in the form of a cone: of course the finger-nails are short; the attempt is made to depress that portion of the uterus against which the fingers push, and thus begin the restoration. The taxis in this case is central, and the part of the uterus restored first is that which came out first. The third method is that first suggested and successfully employed by Nœggerath, and consists in pressure upon one side of the uterus at a point corresponding with the entrance of an oviduct, indenting or depressing the surface there, and thus starting the restoration: this method has been called that of lateral taxis.

After the restoration of the uterus by one or the other of these plans, the hand, of course being in the uterus at the completion of the reduction, is used to detach the placenta and to stimulate, the external hand assisting, the uterus to contract. Barnes says care should be taken to avert what has happened, reinversion, and for this purpose he directs passing along the palm of the hand a uterine tube connected with an injecting syringe and throwing up a pint of hot water, 110° Fahr. If the placenta be found partially separated before restoration of the uterus is attempted, the separation ought first to be completed.

If the physician is not called to the patient until several hours after the accident, or if previous efforts have been made without success, should he at once attempt the reduction? The answer depends upon the condition of the uterus: if it is not inflamed and very sensitive, and if it is relaxed, gentle efforts at restoration may be made even though a day or two has passed. Atthill¹ takes the ground that if an effort at reduction has not been made within twenty-four hours after labor, it is better to wait until after uterine involution has been completed before attempting restoration. The reason for this delay is that the uterine tissues during involution are more liable to be lacerated in the manipulations made in reduction.

¹ *Diseases of Women*, Dublin, 1880.

HEMORRHAGE DURING AND AFTER LABOR.

Hemorrhage as a complication of childbirth is dependent upon different causes: it may be uterine, vaginal, or vulvar. During the first stage of labor, dilatation of the os uteri, it can only occur in case the placenta is partially or completely detached, and hence uterine vessels at its site are ruptured. In the second stage of labor hemorrhage from tears of the neck of the uterus or from those of the vagina is usually prevented by the pressure of the child completely filling the birth-canal in its descent. Bleeding from these injuries, as well as from those of the vulva and perineum, immediately follow the birth of the child. The most frequent cause of bleeding in the placental period of labor and afterward is atony of the uterus.

In considering the subject of hemorrhage arising from placental detachment in the first stage of labor two divisions are necessary: first, bleeding when the placenta is *prævia*; and, second, when the placenta occupies its normal position. The first is commonly known as unavoidable—a term which it will be seen needs to be qualified—and the second as accidental hemorrhage.

Placenta Prævia.—Dr. Edward Rigby, in his valuable essay¹ published more than a century ago, spoke of the placenta as *prævia* when “it is fixed to that part of the womb which always dilates as labor advances.” If we compare this with the definitions given even in recent years, we find that in a clinical point of view nothing has been added to or otherwise essentially changed in it. Spiegelberg has said² that the placenta is *prævia* if a greater or less part of it is situated in that part of the lower uterine segment which must be stretched in labor; this part of the uterus is compared to the segment of a hemisphere which during parturition must be converted into a cylindrical canal. Zweifel says:³ “The lower uterine segment represents a funnel; the narrowed internal orifice corresponds with the internal os. When the child has to pass this part, when the lower uterine segment is stretched and dilated, the funnel gradually takes the shape of a cylinder. The circular fasciculi around the internal os, which formed a ring before it was opened with a diameter only equalling some lines, during the passage of the child’s head has a diameter of eight to eleven centimeters. Thus each circle must be expanded, and the whole tissue of the lower uterine segment becomes very thin. The expansion is not only circular, but also longitudinal. If the placenta is attached in this lower uterine segment which undergoes such important changes during the dilatation of the os, it must become loosened from its attachment.”

¹ *An Essay on the Uterine Hemorrhage*, etc. The first edition of this work was published in 1776.

² *Op. cit.*

³ *Op. cit.*

Forty years ago Barnes first sketched his theory of placenta prævia, and since that period has repeatedly pressed it upon professional attention, the last being in a communication¹ made to the British Medical Association. He divides the uterus into three zones—viz. a fundal, an equatorial, and a lower zone; the superior boundary of the last he called (1847–57) Barnes' boundary-line, "since then sometimes called Branne's os internum, Bandl's ring, or Schroeder's contractions-ring." For him, even if a part of the placenta is attached in the lower zone, there is one of the varieties of placenta prævia, while the grave form occurs when all or the greater part of the placenta grows within this zone. Hart² gives the following definition of placenta prævia: "The placenta is prævia when attached in part in the lower uterine segment—i. e. when it is attached to that portion of the uterine body where the peritoneum is separable. We might also define the placenta as prævia when so placed that a part of it, during labor of course, falls below the contraction-ring."

Frequency and Causes.—Rigby states that of the 108 cases of flooding presented in his volume, "42 were produced by a separation of the placenta, occasioned by its being situated on the os uteri." If the general practitioner met with this condition one-fourth as often as Rigby did, the frequency of placenta prævia would be very great. But this is not the fact. Still, there are wide differences between the statements of different authorities. Johnson and Sinclair found 1 case of placenta prævia in 573 deliveries; Hecker,³ 42 cases in 17,220 deliveries, or 1 in 410; Galabin, Guy's Hospital Lying-in Charity, 1 in 575; the combined statistics of Schwartz, Schwörer, Hegar, and Spiegelberg, as given by the latter, embrace 572,120 deliveries, in which there were 62 cases of placenta prævia, or 1 to 852; Spiegelberg regards the proportion as 1 in 1000. From the combined statistics of Schwartz, Arneth, Klein, Collins, McClintock, and Hardy, with those of the Würzburg Maternity and the Paris Hospital of Clinics, embracing nearly 600,000 cases, I find the proportion of cases of placenta prævia 1 to about 1200.

Ambrose Paré (1575) referred to descent of the placenta before the child—*filius ante patrem* the condition was called—as very dangerous for the mother, and as a certain indication of the death of the child, but was content with the belief, then and for a century afterward generally accepted, that the placenta occupied this unusual position because of its premature detachment and falling down to the mouth of the uterus. When, however, Gottlieb Schacher, professor of obstetrics

¹ *Brit. Med. Journ.*, March 3, 1888.

² *Trans. Edinb. Obstet. Soc.*, vol. xii., 1887.

³ *Beobachtung und Untersuchungen aus der Gebäranstalt zu München umfassend den Zeitraum 1859–79.* By Dr. Carl von Hecker, Munich, 1881.

in the University of Leipzig (1709), made the first anatomical demonstration, by the autopsy of a woman who perished of hemorrhage at the end of her pregnancy, that the placenta was attached over the os uteri, the membranes being unruptured and firmly united to the uterus, many curious explanations of the phenomena were suggested. Epidemic influence was invoked by some, just as until quite recently reputable authorities found in this occult and unknown agent the cause of puerperal fever; Schurigius attributed it to coition in the erect posture; and Oslander held that if a woman just after sexual intercourse sat up the accident would occur, and therefore advised that she should remain some time upon her back or upon one or the other side: in the one case the placenta would be grafted upon the fundus, and in the other upon the side of the uterus corresponding to the side of the body upon which she was lying. Still other causes suggested were the great specific gravity of the ovum and the fecundation of the ovule in the uterine cavity.

Placenta prævia is at least six times more frequent in multiparæ than in primiparæ; there is also a liability to it caused by pluriparous pregnancy. It is more frequent in the poor than in the rich, as Spiegelberg suggests, because of hard work in the early part of pregnancy, or more probably from subinvolution of the uterus: rapidly recurring pregnancies create a predisposition to it, and so too its previous occurrence. Ingleby has reported two remarkable cases, in each of which recurrence of placenta prævia seemed dependent upon the entrance of the tubes near the internal os. Abnormal size of the uterus, diseased condition of its lining membrane, and spasmodic contractions have also been given as causes.

Quite recently Mantel¹ has shown the frequent association of polyhydramnios and placenta prævia, the former, however, according to his view, being the consequence in these cases of the former.

Varieties and Symptoms.—If the centre of the placental disk corresponds with the internal os uteri, the condition is known as central or total placenta prævia; if the os uteri is only covered in part, the term partial is used; if the margin of the placenta is at the margin of the os, the attachment of the former is said to be marginal; while if the placenta does not extend as low as the os, but still is partially within the lower uterine segment, the implantation is called lateral. Considerable latitude must be given to the term "central," for even though the os be completely covered by placental tissue, it is very rare indeed that the distance from the os to the placental margin is the same on each side: in the great majority of cases the membranes can be more readily reached by the finger passing up on the right than upon the left side of the uterine cavity; and this is a fact oftentimes

¹ *Archives de Tocologie*, 1888.

of great practical importance. The term "total" is preferable to "central." With the modification which has been suggested of the designation "central" or replacing it by "total," there is no necessity for retaining the term "partial," so that the varieties may be reduced to three—viz. central or total, marginal, and lateral. Zweifel regards any classification as incorrect, partly on the ground that with the membranes unruptured more and more of the placental tissue protrudes in consequence of the retraction of the os uteri. But when we consider that the danger and the difficulty of treatment are much greater in case of total than in lateral implantation of the placenta, the retention of these terms seems necessary.

Total or central implantation of the placenta is the least frequent, and lateral the most frequent.

Hemorrhage is the most important and characteristic symptom of placenta prævia. This hemorrhage may occur in pregnancy or not until labor begins, and it was to the latter form that Rigby, as we have seen, gave the name of "unavoidable." Nevertheless, it has not been uncommon to accept as unavoidable also the hemorrhage in placenta prævia occurring prior to labor. Admitting the fact, the explanations offered¹ were two: the first was that of Jaquemier, who attributed the necessary detachment of the placenta, explaining the hemorrhage, to a more rapid development of the uterine wall than of the placental tissue; on the other hand, Legroux claimed that the placenta extended itself more rapidly than the lower portion of the uterus to which it was attached: according to the one hypothesis the uterus grows away from the placenta, and by the other the placenta grows away from the uterus, but in either case there is a loss of relation between the placenta and the uterus, and necessary separation occurs, and therefore the hemorrhage is unavoidable. Further, if, as has been claimed by many obstetric authorities, there be in the latter weeks of pregnancy a gradual change in the neck of the uterus, so that the cervical cavity is dilated in order to contribute to the lower uterine segment, thus furnishing increase of space for the growing ovum, hemorrhage must necessarily occur, for all dilatation of the internal os must cause separation of the placenta attached over or close to it. But this view is not now generally accepted. Dr. Isaac B. Taylor has recently² reiterated his statement, first made in 1852, and since that time more than once repeated, that the cervix remains unchanged during gestation. His statement is this: "As far back as January, 1852, I recognized from my clinical observations, instituted from a different method of investigation than the touch alone, that the cervix uteri did not undergo any change whatever to coalesce or

¹ *Placenta Prævia*, by Auvard.

² *Transactions of the New York Medical Association*, 1887.

become absorbed into the body of the uterus during the progress of gestation, but that it remained intact, and was not used up in the general enlargement of the uterus which takes place during pregnancy to accommodate the growing child." He further states that his conclusion as to the cervix remaining unshortened during pregnancy rests upon the examination of 3000 cases. It is obvious that if the statement of Stoltz as to the shortening of the cervix being a normal phenomenon of the last two weeks of pregnancy, and still more that of some other authorities that the uterine portion of the cervix during the last three months is gradually expanded so that it contributes to the cavity of the body of the uterus, be correct, hemorrhage in placenta prævia would inevitably occur during this change. But repeated observations establish the fact that in some cases of placenta prævia hemorrhage in pregnancy has not been observed.

It must be admitted, however, that while growth of uterus or of placenta is not admitted as a cause of premature placental detachment and consequent hemorrhage, there is a loss of relation between the placenta and the uterine wall resulting from the continuous distension of the lower uterine segment. Pinard¹ explains the absence of hemorrhage or of premature rupture of the membranes in such cases as resulting from resistance of the membranes, from resistance of the placenta, from the presentation of the fetus, and the circumstances which prevent the localized pressure and distension occurring up to the time of labor when other factors are concerned. But no matter what hypothesis is held as to the cause of hemorrhage during pregnancy when the placenta is prævia, the bleeding not occurring in all cases cannot be justly termed unavoidable; and some call it also accidental—a term which has generally been limited to hemorrhage consequent upon the premature detachment of the normally-situated placenta. It probably would correspond more accurately with facts to state that in some cases of previous placenta the hemorrhage is unavoidable and in others accidental. The position of the placenta creates a greater liability to the accident; in some cases "the insults of coition," and in all the greater blood-pressure, may be regarded as important factors in promoting premature partial detachment, and consequent hemorrhage. Abortion, as has been stated, may be the consequence of this ectopic development of the placenta; premature labor for like reason may thence result; and Spiegelberg has wisely remarked that even the hemorrhages which occur during the latter months of pregnancy depend upon commencing labor, and that it is not the hemorrhages which induce premature labor, as is generally supposed, but that the converse relation is true.

¹ *Le Col et le Segment inférieur de l'Utérus à la fin de la Grossesse pendant et après le Travail de l'Accouchement*, par H. Varnier, Paris, 1888.

In general, the hemorrhage in placenta prævia prior to labor occurs in the last six weeks of pregnancy. In total placenta prævia, accepting Zweifel's statement, it takes place first between the twenty-eighth and the thirty-sixth weeks, but in lateral first after the thirty-second week. In some cases of lateral insertion there is no hemorrhage during pregnancy. The bleeding may follow exertion, such as lifting, straining at stool, etc.; but often there is no exciting cause obvious, and the flow has begun, for example, when the woman was resting quietly in bed; possibly while sleeping a gush of blood has taken place. The loss of blood in the first attack may be so great as seriously to exhaust the patient, but usually no such grave result is observed; the subsequent attacks are, however, as a rule, more severe. Dilatation of the os proceeds as hemorrhage increases in frequency or in quantity, yet there are exceptions, for there may be a fatal flow of blood with the os only slightly open, as in a case¹ reported by Ingleby which he did not see until just after death, and he found the os so little dilated that the introduction of two fingers was barely possible. Rigby² mentions a case of flooding to which he was called, the woman, who had been bleeding for two hours, dying soon after he entered the room. The uterus was very little open, and he could not feel the placenta. He opened the body the next day: "the placenta was upon the os uteri, and a partial separation of it, no bigger than a crown-piece, was the cause of this fatal hemorrhage."

The hemorrhage has its origin from detachment of that part of the placenta at or nearest the internal os, and it continues, uterine action being presupposed, until the os is sufficiently dilated to permit the passage of the fœtus: when this needful stretching has been attained, no further detachment of the placenta is necessary, and so no more adhesions of the latter to the uterus are ruptured. But meanwhile retraction or pulling up of the os, through the action of the fundus and body of the uterus, goes on, the lower segment of the uterus being, as it were, passively stretched, but also the os dilated and caused to ascend over the ovum. Barnes says: "The form of contraction that prevails in the lower zone is retraction. Longitudinal muscular fibres are continued from the middle zone along the walls of the lower zone, even into the cervix and vagina. Their action is to pull up or retract the lower zone, opening the cervix, thus aiding the driving power of the body of the uterus and the abdominal muscles in canalizing the passage and forcing the fœtus through it. When this retraction is retarded, there is hemorrhage; when retraction goes on well, hemorrhage ceases." This view is of great importance, and will be referred to in connection with the treatment of placenta

¹ *Clinical Lectures on Diseases of the Puerperal State.*

² *Op. cit.*

prævia. It is hardly necessary to state that the bleeding is not from the placenta, but from the uterus.

The **DIAGNOSIS** of placental presentation will be made by uterine hemorrhage often occurring without obvious cause, and suddenly, and the flow being more or less profuse, and placental tissue may be felt by the finger introduced into the os uteri.

PROGNOSIS.—This is very grave for the mother, and especially grave for the child. Spiegelberg regards the maternal mortality, including deaths from puerperal disease, as 30 per cent. Zweifel attributes the increased liability to septicæmia of a woman who has had placenta prævia to the anæmia resulting from the hemorrhages, this anæmia leading to extensive formation of thrombi, and probably to more ready absorption. But probably the chief reason for this greater liability is found in the manipulations required, in the traumatism, and in the readier access of air during the treatment of the condition: the greater relative frequency of shoulder presentations also renders necessary obstetric manipulation. Yet there are some circumstances which materially alter for the better the prognosis. The variety of placenta prævia is an important element. Thus, Depaul's statistics include 25 cases of central insertion, with 14 deaths; 31 of partial, with 3 deaths; and 15 of lateral, with no death. Much depends upon the woman having prompt and proper care, upon the early recognition of the condition, and upon the treatment employed. There is a greater liability to hemorrhage during the delivery of the placenta, and also subsequently, the lower segment of the uterus not contracting so well as the upper portion. Hecker, out of 42 cases—29 lateral, 11 marginal, and 2 central—of placenta prævia, lost 16, 7 per cent.; Spiegelberg's mortality was a little less than 16 per cent., and Barnes' 9 per cent.

The prognosis as to the child is even much worse than that as to the mother. The foetal mortality rarely falls under 50 per cent., and in some statistics rises to 70, or even to 75 per cent., and even higher. In Spiegelberg's experience it was somewhat over 50 per cent.; Barnes puts it at 64 per cent., and Schwartz at 75 per cent.; Hofmeier, 63 per cent.; Behm, 83.4 per cent., etc. The child perishes from asphyxia, not from hemorrhage.

Shoulder presentation is very frequent. Depaul's statistics show that it occurred once in 9 cases. Charpentier in 1148 cases of placenta prævia found this presentation in 24 per cent., and Lomer in 32 per cent. From the attachment of the cord being frequently marginal, its prolapse is not infrequent, and hence increased danger to the child: the frequency too of a transverse position of the child also predisposes to this prolapse.

TREATMENT.—This ought to be such as will secure the least mater-

nal and the least foetal mortality. While, of course, the life of the mother is of the greater importance, yet it is a mistake to ignore all consideration of the life of the child. Dr. Barnes has recently said: "It is no longer permitted to us, without ample proof of clear necessity, to sacrifice the child in order to save the mother. The cases in which the two lives are supposed to stand in antagonism are vanishing before the light of modern science and skill. And in no conjuncture is this more true than in the treatment of placenta prævia." With him I must enter my protest against the teaching of those who openly avow the life of the child is not to be considered, and we should only seek to save the mother.

Now, at least some of the methods that have been advised are attended with very great foetal mortality, as will be seen, and therefore should be carefully considered before being generally adopted. In case of hemorrhage during pregnancy in consequence of the placenta being prævia, the question of active treatment will be determined by the amount of the flow and also by whether the foetus is yet viable. If the flow be slight and the foetus not viable, there is no demand for active interference. It should be remembered that it is not always, even in central placenta prævia, that either the life of the mother or the nutrition of the foetus is interfered with. Kormann advises absolute rest in a horizontal position, and cold water, ice water, vaginal injections; and only in cases where this treatment does not arrest the bleeding which involves danger to the life of the mother is the artificial interruption of pregnancy brought into consideration. Spiegelberg states: "If the hemorrhage is only moderate in quantity, whether distinct pains are present or not, a purely expectant attitude should be adopted, much as is recommended in the case of similar hemorrhages due to abortion; there is at least room for hope that even when the bleeding has begun before the natural end of pregnancy, the latter may continue for a while uninterrupted. This treatment is further recommended by the fact that under the existing circumstances the diagnosis is not, as a rule, quite certain; but the patient and her friends should have their attention called to the condition, and be urged to call in assistance as soon as any unfavorable circumstances show themselves." The teaching of Depaul was similar: "When the hemorrhage begins before labor the treatment does not differ from that used in general for losses of blood occurring in pregnancy: So long as the loss is slight, either in quantity or in duration, we should employ general means—the horizontal position, the hips elevated, cold applications upon the upper part of the thighs and upon the lower part of the abdomen, cold injections in some cases, slightly acidulated drinks, etc."

Nevertheless, if there is serious hemorrhage after the foetus is viable—and it is rare that such hemorrhage occurs before—the induction of

premature labor is indicated; often, indeed, as Spiegelberg has stated, the hemorrhage is caused by premature labor, and the obstetrician simply assists nature's efforts. Statistics prove that both the maternal and the fetal mortality are greater if labor occurs at term than if it be premature, and hence a strong argument in favor of the practice is given. Some of the highest obstetric authorities have pronounced in favor of this treatment. Dr. Thomas, for example, who in 1870 first wrote in advocacy of it, has recently said: "After a large experience I unhesitatingly range myself among the strong advocates for the prophylactic treatment of placenta prævia by premature delivery."¹ Murphy has for some years followed this practice, and his success has been most encouraging, saving all the mothers and 43 per cent. of the children. His special method will now be given in his own words:² "The practice which I follow consists not in a single method for stopping hemorrhage, but in several; and it is this: In the first place, in every one of my own patients or those I am consulted about, when hemorrhage occurs after the seventh month, when it is clearly not from the cervix or os, and when there is presumptive evidence that it is from the placenta prævia, I advise premature labor to be introduced, or before that period of pregnancy when the hemorrhage is severe, continuous, or frequently recurring. In cases that admit of a little delay from the symptoms not being very urgent, I appoint a time when I can give a few hours' continuous attendance—two hours is generally sufficient—as, once you commence to induce labor, I consider it necessary to remain with the patient until delivery is accomplished; and when the case does not require instant action, one can fix his own time and can have what assistance he requires.

"I find having an assistant a great advantage, and by thus arranging a definite time practitioners can secure the services of a specialist or fellow-practitioner to help them and to share the responsibility. On examination, if the cervix will permit it, I introduce my finger, separate the placenta all around, and then put in a Barnes bag; and if not, I gently and slowly insinuate my finger through the os, which I have always found easy of accomplishment, never having had recourse to the preliminary introduction of a tent, though in inducing labor for other causes I have had frequently to introduce tupelo tents. Having thus dilated the cervix with my finger, I separate the placenta freely around the internal os, and at once introduce a Barnes bag. I slowly fill it with water. And here let me give a practical hint on the use of hydrostatic bags which I do not remember to have seen mentioned in any of the textbooks: When the bag is well through the cervix it is very difficult to say how full it is, and by continuing the injection it

¹ *Transactions of the New York Medical Association*, vol. iv.

² *Medical Press and Circular*, 1885.

may very easily be burst, as once happened to myself, and has, I know, happened to many others; so, to avoid this, it is desirable to ascertain and remember how many syringefuls each bag requires before it is fully dilated, and then to carefully inject only that number. Having thus filled the bag, I wait patiently until the os is well dilated around it, and, before introducing another one, separate the placenta further shore the hemorrhage continue, which it does not, provided the placenta has been sufficiently separated at first. After the bag has been introduced for some time the pains come on fairly well, though as a rule they are not very strong.

"I thus proceed until the os is fully dilated, when I give ergot freely, and decide what is the most suitable course to follow. If the placenta is lateral or marginal and the pains fairly strong, I rupture the membranes and leave the case to nature; or if the head is well into the pelvis I may apply the forceps; but in the great majority of cases I perform version, preferably by the combined method, and deliver the child as quickly as is consistent with the safety of the mother."

If the practice of Murphy be adopted, the obstetrician must be most careful in carrying out the method to use antiseptics—an antiseptic vaginal injection preceding the dilatation and continued from time to time during it, and the Barnes bags employed must be perfectly clean and dipped in such solution before introduction: after the labor is over the uterus, at least its lower portion, is to be washed out with a hot solution of corrosive sublimate—1 part of the mercurial to 4000 of water.

The treatment of placenta prævia when labor occurs spontaneously, whether at term or previous to this time, can be most conveniently considered by presenting the chief methods that have been employed. These are turning, the tampon, rupture of the membranes and partial detachment of the placenta, and dilatation of the os uteri. Podalic version in the treatment of placenta prævia is not a new practice. The "judicious" Denman nearly a century ago taught it, saying that no "regard is to be paid to the part of the child which may present, for it must always be delivered by the feet;" he also taught that when the hand is carried to the placenta attached over the os uteri, it is of little consequence whether we perforate the placenta with our fingers or separate it on one side till we come to the edge, though the latter is generally preferable. As has been stated, Rigby (1776) maintained that the hemorrhage in case the placenta was situated over the mouth of the womb was unavoidable, and "could not possibly be suppressed by any other method whatever than the timely removal of the contents of the womb;" and to this end he used, if necessary, digital dilatation of the os, and then podalic version with extraction of the fœtus: it really was what is known as *accouchement forcé*. Obstet-

ricians before Portal had demonstrated that the placenta might be attached over the mouth of the womb, and sought to combat the consequent hemorrhage by podalic version.

Braxton Hicks¹ in 1860 presented his method of performing version, and spoke of it as especially applicable to cases of placenta prævia: the reasons for its applicability in the latter condition were that it was possible to turn when the os was only sufficiently dilated to admit the finger, by which the knee or foot of the fœtus could be brought down, and by drawing it through the os perfect command of the hemorrhage, as well as of the labor, could be secured: in a subsequent contribution² he urged the importance of not delivering the child rapidly after the performance of version, and stated that when so much of the child has passed through the cervix as its dilatation will allow of, a gentle traction—merely the weight of the arm, he believed—would restrain any further bleeding.

Lomer has recently³ given the following description of his practice: "Turn by the bimanual method as soon as possible, pull down the leg, tampon with it and with the breech of the child the ruptured vessels of the placenta. Do not extract the child then; let it come itself, or at least only assist its expulsion by gentle and rare tractions. Do not wait in order to perform turning until the cervix and os are sufficiently dilated to allow the hand to pass: turn as soon as you can pass one or two fingers through the cervix. It is unnecessary to force your fingers through the cervix for this. Introduce the whole hand into the vagina, pass one or two fingers through the cervix, rupture the membranes, and turn by Braxton Hicks' bimanual method. Use chloroform freely in performing these manipulations. If the placenta is in your way, try to rupture the membranes at its margin; but if this is not feasible, do not lose time; get hold of a leg as soon as possible, and pull it down." It is plain that there is not an essential part of this treatment, if we except perforation of the placenta in some cases—and that means death to the child—which was not taught by Hicks more than twenty years before. Zweifel refers to "the new treatment" as sustained by a large collection of brilliant results, stating that it was recommended by Braxton Hicks and Kaltenbach, and first practised in a large number of cases by Hofmeier. The last in 37 cases lost only 1, while Behn did not have a single patient die in 40. As has been previously stated, the fœtal mortality if this method be employed is very great; and Zweifel suggests, for the purpose of lessening this, to avoid perforating the placenta: the plan he proposes is to have the woman lying upon her side while the obstetrician introduces two fingers into the uterus anteriorly until they pass above the

¹ *Lancet*, July, 1860.

² *Transactions of the London Obstetrical Society* for 1863.

³ *American Journal of Obstetrics*, 1884.

pubic symphysis, for thus the fingers can be carried farther up in the cavity of the uterus, and hence more probably attain the membranes. He mentions a case of placenta prævia totalis in which he was successful by this method, avoiding perforation of the placenta and saving both mother and child.

The tampon treatment is an old one also. Credited by the French to Leroux (1776), it ought to be remembered that his use of the tampon was advised in uterine hemorrhages in general, and not especially for those caused by the placenta being prævia; Wigand was probably the first to systematically employ this means in the condition just mentioned. I have elsewhere¹ given the details of Wigand's method which he employed for many years, and which in suitable cases he claimed always saved the lives of both mother and child. If the pains were active and the position of the child favorable, Wigand, after the introduction of the tampon, left the further progress of labor to nature, the plug being expelled immediately before the child. Many eminent obstetricians, especially among the French, have similarly employed the tampon. The *colpeurynter* as a tampon in placenta prævia has been advised by some, while others reject it because it cannot be perfectly adapted to the vaginal vault; another objection is that it may be the medium of infection or it may tear. Spiegelberg states that "if the cervix is not canalized and dilatable, so that immediate delivery appears out of the question, plugging must be resorted to—not with india-rubber bags, which exert but little pressure on the lower segment of the uterus," etc. A tampon may be made of absorbent cotton formed in balls about the size of a small walnut; fifty or sixty of these will be required—a hatful, according to Pajot. The bladder and rectum are first emptied and the vagina thoroughly washed out with an antiseptic solution, all clots being carefully removed; the patient may lie upon her side or upon her back: the former position is necessary if a Sims' speculum is used, but this instrument is not essential in order that the vagina may be thoroughly tamponed. The practitioner seizes with forceps one of the cotton balls, and after coating it with an antiseptic ointment, carries it up to the vaginal vault; one after another is thus introduced until the vault is completely packed; the os is covered with the cotton packing, or if possible one or more of the balls passed into it first, and then the rest of the vagina is filled, a large piece of cotton placed between the labia, and the whole secured by a napkin and a T-bandage. It is not advisable to dip the cotton balls in astringent solutions, for then they needlessly irritate or may inflame the vaginal walls; and the essential idea involved in this application of the tampon is arrest of hemorrhage, not by coagulation of the blood, but by direct pressure. If the cotton balls are

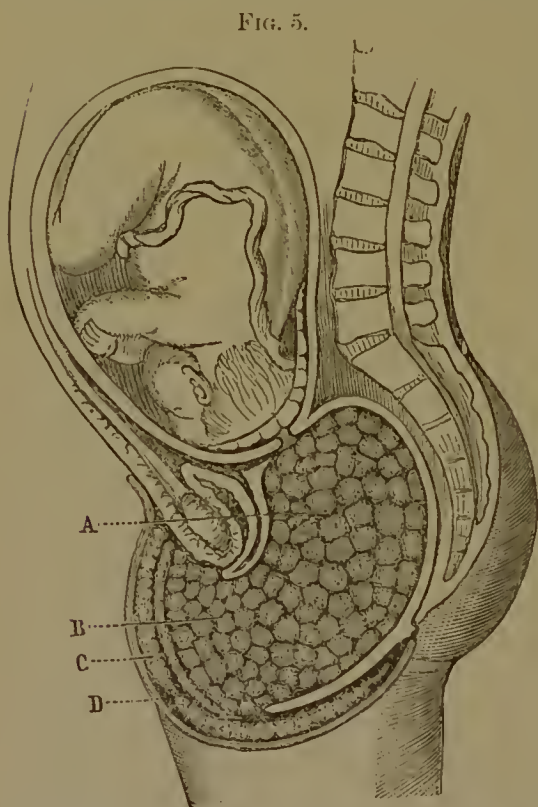
¹ *Science and Art of Obstetrics.*

covered with an ointment they do not become soaked with fluids and lessened in size; moreover, thus prepared the vagina can be more thoroughly packed; a uniform mass completely distending it is formed.¹

One of the benefits of the tampon in the majority of cases is that it causes vigorous uterine contractions. The chief objections that have been made to it are that it may convert an open into a concealed hemorrhage, and that septicæmia is liable to follow its employment. In answer to the first objection, it may be confidently asserted that bleeding will not follow a properly-applied and carefully watched tampon. The reply to the second objection is that septic infection is impossible if the vagina be first thoroughly cleansed and then antiseptically closed. Zweifel remarks that tamponing is wholly rejected by some, and at best is only permissible when the vaginal portion still remains

and in the absence of pains; yet on the other hand, they recommend the colpenrynter strongly, so that strict disinfection is possible; but he admits that in case cotton that has been sterilized by heat or by impregnation with iodoform is used the chief objection is removed.

The tampon may be left in place for twenty-four hours, if necessary, without injury; Depaul did not remove it for twelve or fifteen hours at least, or for twenty-five or thirty hours at most. After its removal the vagina must be thoroughly cleansed with an antiseptic solution, when a new tampon is introduced if hemorrhage continues or immediate delivery is impracticable; in certain cases, the presentation being normal, some practitioners, fol-



Vaginal Tampon in Placenta Prævia: A, deeply-placed dossils, to each of which a cord is attached; B, superficial dossils without cord; C, pledget of charpie or pad of cotton; D, T-bandage.

lowing the method of Wigand, among whom may be mentioned Pajot and Bailly, wait the expulsion of the tampon by the same contractions that expel the child. The method just mentioned, however, is rarely employed by practitioners now, the majority regarding the tampon as

¹ Strips of iodoform gauze may be very well employed for a tampon.

simply a temporary means. Müller,¹ after remarking that it is neither a sovereign remedy, as its friends claim, nor to be entirely rejected, as its enemies desire, states that it is an important aid which should be used at the right time, and then no longer than is necessary: apply it when the os is rigid and only slightly opened if violent hemorrhage occurs, for immediate delivery is impossible; time is thus gained without danger, for even if it does not stop it lessens the bleeding, and prepares the parts for labor. According to statistics given by Auvard, when the tampon was used the maternal mortality was 6 per cent. and the foetal 55 per cent.²

Rupture of the membranes was first advised by Puzos in the treatment of placenta prævia in 1759, and it is known as his method. But dilatation of the os with the finger preceded rupture of the membranes. If the discharge of the amniot fluid be followed by vigorous uterine contractions, the result as to hemorrhage is favorable; the lessened size of the uterus permits retraction of the os, but if such contractions fail, then the hemorrhage is increased or at least not lessened. According to Auvard, the results of this method are a maternal mortality of 13 per cent. and a foetal of 46 per cent.

Detachment of the placenta was brought before the profession by Radford in 1819, and by Kinder Wood³ in 1821, as a conditional or exceptional operation, and by Simpson⁴ in 1845. This method, never regarded by its advocates as of common, but only of occasional, application, is to-day almost without any supporters.⁵

Partial detachment of the placenta has been advocated and practised by Barnes, Cohen, and Davis. Barnes' method is founded upon the proposition that the "physiological arrest of flooding is neither permanent nor secure until the whole of that portion of the placenta which had adhered within the lower zone of the uterus is detached, that being the portion which is liable to be separated during the opening of the lower segment of the uterus to the extent necessary to give passage to the child." The following are his directions: "Pass one or two fingers as far as they will go through the os uteri, the hand being passed into the vagina, if necessary; feeling the placenta, insinuate the finger between it and the uterine wall; sweep the finger round in a circle, so as to separate the placenta as far as the finger can reach; if you feel the edge of the placenta where the membranes begin, tear open the membranes freely, especially if they have not been previously ruptured; ascertain, if you can, what is the presentation of

¹ *Placenta Prævia*.

² Schatz regards the tamponade of the vagina as better than the colpeurynter (Winckel, *Lehrbuch der Geburtshülfe*).

³ *London Lancet*, 1847.

⁴ Simpson's *Works*.

⁵ A qualified approval is given it in some cases by Prof. Alexander R. Simpson. (See his *Contributions to Obstetrics and Gynecology*, p. 84.)

the child before withdrawing your hand. Commonly, some amount of retraction of the cervix takes place after the operation, and often the hemorrhage ceases. You have gained time. You have given the patient the precious opportunity of rallying from the shock of a previous loss and of gathering up strength for further proceedings.

"If, the cervix being now liberated under the pressure of a firm binder, ergot, or stimulants, uterine action returns so as to drive down the head, it is pretty certain there will be no more hemorrhage; you may leave nature to expand the cervix and to complete the delivery; the labor, freed from the placental complication, has become natural."

Dr. Barnes has recently stated that his method gives 33 per cent. of children born alive, and that concurrently with a larger saving of mothers than has been secured by any other methods. Certainly the method in the hands of Murphy, as previously explained, has given better results than any other. Cohen's method—that of Davis is similar to it—consists in the introduction of the index and medius in the os, and causing them to penetrate between the placenta and the uterus in that direction which offers the least resistance, separating the former until the membranes are reached, when they are ruptured, and the fingers hooked over the placental margin draw it toward the vagina, causing it to project from the womb. It has not the physiological basis upon which that of Barnes rests, and cannot supersede it: it probably has only the effect of the treatment advised by Puzos, rupture of the membranes, though possibly the drawing down of the liberated portion of the placenta may slightly facilitate the descent of the presenting part of the fœtus, and thus direct pressure upon the bleeding placental site is secured. Barnes, with other eminent authorities, holds that when the lower uterine segment is converted into a cylinder sufficient in diameter for the transmission of the fœtus, no more placental tissue is detached, and the hemorrhage, if there be efficient uterine action, ceases. Accepting this, the statement as to treatment advised by Spiegelberg is to be rejected. He, after stating that the arrest of the hemorrhage at the area of placental attachment brought about by contraction or diminution of the latter, by the consequent narrowing of their wounded vessels, and to a less extent by thromboses of their lumina, adds: "A satisfactory degree of contraction, however, is only possible when the uterus is completely emptied; and the end, therefore, which must, above all things, be kept in view, is to effect this as quickly as possible." This was the teaching of Rigby, and it fails in the recognition of the fact that the hemorrhage usually ceases under the circumstances previously mentioned, and it is doubtful whether it gives proper regard to the interests of the child. The obstetrician may be called when the patient is so exhausted by flooding that life is almost extinct, and she may die while he is endeavoring to

deliver or immediately after delivery. Rigby refers to the unjust reproach he may suffer from the public if there should be such unfortunate event. But he adds the following golden words, which are worthy to be treasured up by every obstetrician: "These may be tolerable arguments in trade, but they are unjustifiable ones in morals, which direct us always to do what is in itself right, independent of the opinions of the world and the consequence that may follow it."

Nevertheless, in such cases immediate interference will depend upon whether the hemorrhage continues or has been arrested. If the latter be the case, the attendant should first address his efforts to relieving the prostration. Stimulants may be given by the mouth if the stomach will tolerate them; hypodermics of sulphuric ether, the introduction of fluids into the rectum and into the stomach, so as to compensate for the loss of blood as soon as possible, are indicated. In reference to the value of fluids thus employed, the following passage from Zweifel is of interest: "Recently several very interesting contributions have been made, showing very clearly that which is especially accomplished by transfusion, the refilling of the blood-vessels with fluid. Even after the greatest loss of blood, enough blood is left in the circulation to supply the centres of respiration and enable them to perform their function. But the remaining blood and its oxygen no longer reach these centres, for the movement of the blood stops. If the heart, because of the hemorrhage, is supplied with less blood continuously, it pumps out its contents and becomes empty and paralyzed. Even though the animals experimented upon were brought into a state of extreme anæmia, and had reached the point of asphyxia, an alkaline solution of salt, 0.5 per cent., restored them so completely that they were able to walk after they were untied. The practical significance of these experiments is very great, for it shows the suitable treatment, which consists in bringing the greatest amount of fluid possible into the circulation; and this should be done through the natural channels—by the mouth or by the rectum, or by both at the same time."

After reaction has been secured the obstetrician proceeds with the requisite special treatment. The placenta may be discharged immediately after the child, but in some cases it is still adherent at some parts, and then these adhesions must be broken and the organ removed by hand. A hot solution of corrosive sublimate, 1 : 4000, should be injected into the lower part of the uterus as a safeguard against hemorrhage and infection. If hemorrhage occurs and does not yield to the hot water, there may be pressed upon the bleeding surface a sponge previously dipped in vinegar, or a solution of iodine or of one of the salts of iron may be brushed over it. According to Spiegelberg, the cervix and the vaginal fundus may, if necessary, be firmly plugged, while pressure from above, made first with the hand, afterward with

a pad and binder, meanwhile prevents the uterus from ascending and compels it to remain contracted and to keep in the place it had assumed.

The great importance of careful observance, not merely of cleanliness in all the manipulations and instruments employed in the treatment of placenta prævia, but of careful and thorough antisepticism, cannot be too strongly enjoined. It is but a trifling victory to save a poor woman from the peril of hemorrhage, and then permit her to perish by possibly a preventible septic infection. Let the obstetrician never forget that the liability to septic infection is greatly increased by placenta prævia, and be prepared to use all means to avert this imminent danger.

Accidental Hemorrhage.—The so-called accidental hemorrhage, or that which occurs from premature detachment of the normally-situated placenta, is not frequent, and especially its grave form is rare. The hemorrhage may be open or concealed, or both forms may be present. The detachment of the placenta, usually partial, causing it, may be the consequence of general disease, such as variola, scarlatina, typhoid fever, or of local disease, nephritis or acute yellow atrophy of the liver. Excessive distension of the uterus has been observed in some cases, while in others it has been the consequence of violent straining at stool, lifting a heavy weight, or severe coughing. Probably, however, the most frequent cause has been some local injury, as from a blow or a fall. In illustration of this origin the following cases are given, the first occurring during one of my terms of service at the Philadelphia Hospital, and reported by my then resident, Dr. J. C. DaCosta, and the second reported by Kormann: "J. L——, thirty years of age, multigravida, when at the end of the seventh month of pregnancy slipped and fell, the right iliac region striking a boiler. She immediately had severe pain, and blood flowed from the uterus to the amount of nearly a quart in a few minutes; then stopped. The finger readily entered the uterus. The pulse was very rapid and weak, the expression anxious; body agitated with tremors and covered with cold sweat; pupils dilated; heart's action weak, irregular, and beats intermittent; respiration shallow and hurried. Immediately upon being placed in bed she was given whiskey and aromatic spirits of ammonia; the head of the bed was lowered by raising the foot, the vagina was washed out with a hot solution of corrosive sublimate, and opium given freely. The hemorrhage did not return, and the pain gradually subsided in two days. The pregnancy went to term, when she was delivered of a healthy, well-developed child."

Kormann's case is as follows: "A multipara, desiring to finish some household duties, fell down a steep flight of steps into the cellar, and when carried to bed showed symptoms of grave uterine hemorrhage.

Upon my arrival I found her dying: the os uteri was dilated to the size of a dollar, and was soft; the uterus was greatly distended, and the child was dead. Cæsarean section done immediately after her death confirmed the fact of the child's being dead, and showed that the placenta had been almost completely detached, and that the blood from the uterine surface had passed through a rent in the membranes into the foetal sac, hence enormous dilatation of the uterus, and also a fatal hemorrhage without discharge of the amniot fluid."

More frequently in case of concealed hemorrhage the blood, instead of entering the foetal sac as in the case of Kormann, collects between the external surface of the ovum and the internal surface of the uterus, either between the placenta or the membranes and the uterus.

The SYMPTOMS of concealed hemorrhage are an acute anæmia, shock, severe pain, and excessive distension of the uterus; in some instances the seat of this severe uterine pain is marked by an unusual prominence caused by the accumulated blood.

The PROGNOSIS in concealed is much more grave than it is in open hemorrhage, for usually in the latter the flow is not great or there is a sudden gush and then the hemorrhage ceases, as in the case first reported. Goodell, in referring to the diagnosis of concealed hemorrhage, states¹ that "very often before the lapse of many hours a show of blood, ranging from an ooze to a gush, will clear up all obscurity; but this trustworthy symptom does not usually occur at the outset of the attack, but at a time when it may be too late to interfere." It is obvious, therefore, that in cases of both internal and external hemorrhage the prognosis is as serious as in those in which only the former occurs. Goodell's collection of 106 cases of internal hemorrhage gave a maternal mortality of 51 per cent., while the foetal mortality was 94 per cent.

TREATMENT.—If the hemorrhage be external and continuous, in addition to the use of stimulants and other means to bring about reaction the vaginal tampon is indicated, provided the accident does not happen in labor, the os being so well dilated and the uterine action so vigorous that delivery can be soon accomplished, and under the latter circumstances rupture of the membranes is indicated, followed by careful compression of the uterus and the administration of ergot.

In case of concealed hemorrhage the practice generally advised is rupture of the membranes, followed by uterine compression. Spiegelberg, however, takes the ground that as long as the effused blood continues in the uterine cavity and stretches its parietes, this stretching and the raised intra-uterine pressure prevent any more blood being poured out, while, conversely, if the uterus is emptied, fresh bleeding may at once begin. But, as is known—the case of Kormann, for example,

¹ *Am. Journ. Obstet.*, vol. ii.

illustrating the fact—distension of the uterus is an uncertain reliance for the arrest of hemorrhage; nay, this organ may so yield to the pressure of the effused blood that a woman may perish in a few minutes without a drop of blood having escaped externally. Uterine contraction furnishes a more reliable hæmostatic than is found by pressure in uterine expansion, and this contraction is only possible after evacuation of the liquor amnii.

If the os uteri be sufficiently dilated to admit of immediate delivery either with forceps or by podalic version, the one or the other is to be employed; if it be undilated, digital dilatation or Barnes' dilators will be employed. It is not necessary to urge the importance of position, of stimulants, and of hypodermic ether for the purpose of combating the prostration and averting the danger of instant or of speedy death.

Hemorrhage in the Third Stage of Labor, or Following it.—The hemorrhages following childbirth, as was stated previously, have different causes, and of course require different treatment. Vaginal and vulvar injuries as sources of these bleedings have been considered, and methods of treating them directed. The field is still more restricted, for there have already been presented inversion and rupture of the uterus and lacerations of the cervix, with the treatment necessary, including that of the bleeding that may originate in any one of these accidents. There remains, therefore, only that bleeding which occurs from the placental site after the expulsion of the fœtus.

The separation of the placenta from the uterus wounds the latter, the blood-vessels where the former was attached are torn, and the prevention of bleeding from these open vessels is made in part by the formation of coagula, but chiefly by retraction or tonic contraction of the uterus; thereby "thousands of living ligatures" are drawn around these vessels and their open mouths closed. From the fact that this bleeding results from a failure of tonic contraction of the uterus it is commonly called "atonic hemorrhage."

This is the variety of serious post-partum hemorrhage which is most frequently met with, and yet its most common causes are preventible, and its frequent occurrence in the hands of a practitioner may be taken as a proof of ignorance or of negligence. Weak uterine contractions in the first and second stages of labor may be the heralds of inefficient uterine action in the third stage or after its completion. If the uterus be rapidly emptied by the forceps or spontaneously, and care is not taken to "follow down" with the hand upon the abdomen the lessening organ as its contents are removed; if there be no watchful care of the patient during and after the expulsion of the placenta; if the woman be allowed to sit up soon after labor, though but for a few minutes, to evacuate the bladder, for example,—the flooding may occur. Not only rapid delivery, but frequently-recurring pregnancies;

very great uterine distension, as from pluriparity or from polyhydramnios; changed condition of the blood, as in albuminuria; exhaustion from disease or from protracted labor,—are causes that create a liability to post-partum hemorrhage. Clot or placenta obstructing the os uteri may permit accumulation of blood in the uterine cavity, thus distending it until all the barriers to abundant bleeding from the placental site are removed. The flow, instead of being internal, may be external, and the red stream dripping through or flowing from the side of the bed tells the startling story of instant peril.

The SYMPTOMS of post-partum hemorrhage are, in addition to that which has been mentioned as possibly occurring when the bleeding is external, very striking, and cannot escape the observation of even the inexperienced practitioner. The thirst, the death-like pallor of the face, the sighing and gasping, the restless tossing of the arms as if blindly seeking help, the dilated pupils, and the dim or lost vision of which, with “ringing in the ears,” the patient may complain,—all these make a picture, sometimes sudden in its recognition if not in its apparition, which will at once declare the imminent peril and its cause, and must remain for ever fixed in the memory.

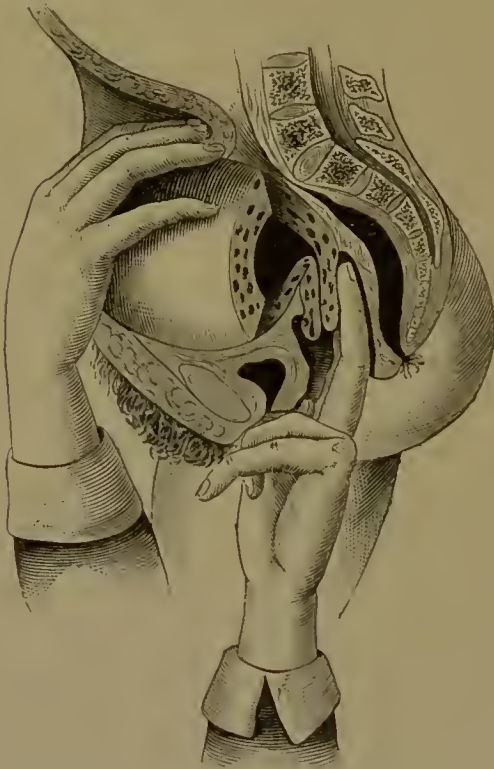
TREATMENT.—If ever there is a time more than any other in the obstetrician’s life when he needs to be calm and collected and to put forth prompt and intelligent action, it is when he is brought face to face with post-partum hemorrhage. If he participates in the anxiety and alarm of bystanders, he will hesitate and falter in the instant use of necessary means, and fear becomes panic, while the peril of the unfortunate patient is increased by every minute’s delay and by her loss of faith in him; but if, on the other hand, he is armed with that self-confidence which comes from knowledge, he inspires others with confidence, and they render prompt and wise obedience to his directions, and he, doing the right thing at the right time and in the right way, will generally have the unspeakable reward of saving a fellow-being from swift death.

In addition to lowering the patient’s head and the administration of stimulants and of hypodermic injections of sulphuric ether, etc., applicable in other cases of bleeding with consequent exhaustion, we use direct means to arrest the bleeding. First of these is uterine compression. The usual method of doing this is to grasp the uterus through the abdomen with one hand, while the other is introduced into the uterine cavity in order that its presence may evoke uterine contraction. Possibly, too, the placenta may still be in the uterus, either free or partially attached; in the latter case the fingers are used, as the uterus lessens in size, to detach it, and in either case to remove it from the uterus at the proper time. Probably the uterus is very sensitive when pressed by the abdominal hand, but this arises from its great distension, and as soon

as the organ is emptied the excessive sensibility ceases; possibly the uterus cannot be felt at first by this hand—it is so relaxed that it has lost its form—but then so much the more need of prompt action.

Should this means fail in arresting the hemorrhage, compression of the uterus, placed in a position of ante flexion, may be employed: Zweifel says it ought to be possible to stop every atonic hemorrhage by energetic use of this treatment.

FIG. 6.



Arresting Hemorrhage by Compression of the Uterus in a position of ante flexion (Zweifel).

In the performance of this method pass two fingers into the posterior cul-de-sac, and press the cervix forward, while the other hand, upon the abdomen, is made to press upon the fundus posteriorly, bringing it also forward, as shown in the accompanying illustration.

Compression of the abdominal aorta may be made with the fingers of the left hand, the obstetrician being upon the patient's right side: the abdominal wall is depressed just above the uterus and a little to the left of the median line until the pulsations of the vessel are felt, and then slight pressure with the first three fingers will arrest the current. An assistant will be needed, for the fingers become too tired after twenty or thirty minutes to maintain efficient compression.

Compression of the abdominal aorta was probably first advocated by Rüdiger, a practitioner of Tübingen, in 1797. His method was with the hand introduced into the uterus, pressing through its posterior wall. Ulsamer in 1825 introduced the method of pressure through the abdominal wall, and it received the strong indorsement, from personal experience, of Siebold and of Baudelocque. Gros¹ has reported nine cases of puerperal hemorrhage in which it was successfully employed. Zweifel holds—that this objection has been made by Jacquemier and others—that it is impossible to cut off by this means all the blood-supply to the uterus, because the spermatic arteries pass off from the aorta above

¹ *De la Compression de l'Aorte dans les Hémorrhages pour après l'Accouchement.*

the part compressed, and that the chief benefit is in preventing cerebral anæmia, in this respect being upon the same level as bandaging the limbs or what is known as auto-transfusion.

Uterine contractility has been in some cases evoked by flapping the abdominal wall with a wet towel, by pouring cold water from a height upon the exposed abdomen, by the application of ice to it, by the introduction of pieces of ice into the vagina or into the uterus, or by the injection of cold water into each. In recent years, however, the general preference has been for injection into the uterus of hot, rather than of cold, water, the former being more efficient than the latter in producing permanent contraction and stimulating rather than depressing. The water should have a temperature of not less than 105° Fahr., and the injection be made by an irrigator rather than by a pump. The application of vinegar to the interior of the uterus was probably first advised by Leroux¹ in 1776. Since then many obstetricians have regarded this remedy as of very great value. Dr. Penrose,² for example, states that he has been using it alone as his last resort, both in hospital and private practice, in many apparently desperate cases of post-partum hemorrhage, and invariably with successful results. His method is the following: "I pour a few tablespoonfuls into a vessel; dip into it some clean rag or a clean pocket-handkerchief. I then carry the saturated rag with my hand into the uterus, and squeeze it; the effect of the vinegar flowing over the sides of the cavity of the uterus is magical. The relaxed and flabby uterine muscle instantly responds." Similar stimulating applications have been successfully made to the interior of the uterus—*e. g.* whiskey. Betz³ succeeded in arresting post-partum bleeding by introducing into the uterus a sponge upon which chloroform had been poured; and it has been claimed that this agent acts by a powerful excitement of the walls of the vessels either directly or through the vaso-motors, and that it is incomparably more energetic than vinegar similarly applied.

The employment of a styptic solution of one of the iron salts has been resorted to with success. There are three ways in which such a solution is used—by injection, by swabbing, and by tamponing. Dr. Robert Barnes has been the especial advocate of the first. The following quotation⁴ gives the formula for the iron styptic employed by him and his method of using it: "Solid ferric chloride ʒj, dissolved in ʒx of water, or the liquor ferri perchloridid. (Br. Ph.) ʒjss, water ʒviijss. The rules in using it are: (1) be sure that the uterus is empty

¹ *Observations sur les Pertes du Sang des Femmes en Couches.*

² *Transactions of the American Gynecological Society*, vol. iii.

³ *Revue Médico-chirurgicale des Maladies des Femmes*, 1886.

⁴ *Obstetric Medicine and Surgery*, vol. ii. p. 292.

of placenta, blood, and clots ; (2) compress the body of the uterus by the hand during the injection ; (3) have two basins at hand, one containing hot water, the other the ferric solution ; pump water well through the syringe—a good Higginson's will do—so as to expel air ; then pass the uterine tube into the uterus, and inject first hot water, so as to wash out the cavity and give a last opportunity for evoking diastaltic contraction ; then shift the receiving end of the syringe into the ferric solution, and slowly, gently inject about seven or eight ounces, carefully keeping up steady pressure on the uterus throughout and afterward."

Dr. Wynn Williams¹ has advised applying the iron solution by means of a sponge to the interior of the uterus. He directs pouring some of the tincture of the perchloride of iron into a sponge, which is then passed into the hollow of the hand already in the uterus, clots from the latter having been removed, and then the walls of the uterus are thoroughly sponged over.

Tamponing the uterine cavity with cotton that has been dipped in a solution of the chloride of iron is regarded by Zweifel as only a final resort when all other appropriate means have been vainly tried ; and he refers to one case, the only one in which he tried this heroic treatment, which recovered with very slight elevation of temperature. He directs two or three tampons to be dipped in a solution of chloride of iron, and then pressed directly upon the placental site, while external pressure is simultaneously made upon the uterus ; if the bleeding still continues, the application is repeated until it stops. He prefers this treatment to injections of an iron solution, stating that he has seen one patient die after such injection, and another recover after the tampon.

There are delays, difficulties, and dangers in transfusion which render it unavailable in the great majority of cases of acute puerperal hemorrhage, at least in general practice, though some of these obstacles are not found in hospital practice. Very few practitioners have the suitable apparatus ; and if they have it, from rare use it is usually not in working order. Nor is the necessity for transfusion so great when we know how prompt hypodermics of sulphuric ether are in rallying a patient from the collapse caused by hemorrhage, and how efficient the introduction of fluids through the natural channels, as previously stated, is in reviving a flagging, faltering heart.

Auto-infusion has upon theoretical grounds and from small experience somewhat to recommend it. By bandaging the members so that the blood which they contain is pressed out, and thus contributes to sustaining vital functions, possibly at times imminent death may be averted. But, on the other hand, death may be thus invited, for

¹ *London Obstetrical Society's Transactions*, 1870, vol. xi.

fatal pulmonary embolism has followed the employment of this means.

Secondary Hemorrhage.—The subject of hemorrhage in connection with labor cannot be dismissed without briefly referring to a form of this disorder occurring one or more days after delivery during the puerperal period, and which is commonly called secondary. The most frequent cause is the retention of fragments of placenta or of membranes; a placenta succenturiata has in some cases given rise to dangerous hemorrhage. Several cases have been reported in which the retention of a blood-clot has caused flooding. Ordinarily, the uterus is adequate to the expulsion of clots that may form in its cavity, but sometimes, this expulsion failing, the clot increases in size; the lochial discharge is scanty and serous; the uterus, though notably increased in size, is firm and resistant; for a time the clot acts as a tampon pressing upon the placental site, and thus prevents hemorrhage. After some days the coagulum spontaneously breaks up, the protecting pressure is at once withdrawn from the open vessels at the placental site, and a hemorrhage which is perilous or may be instantly fatal at once follows. In some instances a uterine fibroid or polypus has been the cause of secondary puerperal hemorrhage. Mental emotion has in several instances produced it. Lactation, sexual intercourse, too early assumption of the erect position or engaging in household duties, the influence of malarial poisoning, and certain displacements of the uterus have been mentioned as causes. Among very rare cases may be stated one reported by Hewitt¹ of fatal hemorrhage the sixth week after labor from traumatic aneurism of the uterine artery, and one by Johnson² and Sinclair in which death occurred the fourth day following delivery from rupture of a uterine thrombus.

In regard to the special treatment of secondary hemorrhage, the importance of removing any foreign body, as a fragment of the placenta or clot, from the uterus is to be borne in mind. In regard to the method of emptying the uterus of a mass of coagulated blood which distends the organ, the fingers, Pajot's curette, or a stream of carbolized water may be employed. During this removal compression of the uterus externally is important in order to secure retraction of the organ and thus prevent hemorrhage. The cases are rare in which the uterus is not able to empty itself, but certainly some occur in which direct means must be used for the purpose, and thereby possibly a fatal hemorrhage may be prevented; thus Contamin³ found in 6 out of 56 cases of secondary hemorrhage an intra-uterine coagulum the cause.

¹ *London Obstetrical Society's Transactions*, vol. ix.

² *Practical Midwifery*.

³ *Étude sur les Hémorrhagies*.

ECLAMPSIA.

Eclampsia, adopting Bailly's definition, is an acute disease occurring during pregnancy, labor, or childbed, often sudden in its onset and rapid in its progress, characterized by convulsions, with loss of sensation and consciousness, and ending in coma. The sudden attack is indicated by the word "eclampsia," from *εκλαμπω*, to shine out, to flash.

The disease is most frequent during, least frequent after, labor. Nevertheless, the relative frequency of eclampsia in pregnancy and in labor is not conclusively determined, for, the latter so often coming on as a consequence of the convulsive attacks, many of the cases which really belong to gestation may be recorded as occurring during parturition.

FREQUENCY.—In regard to the proportion of women affected to the entire number of deliveries statistics vary: Hecker, 1 in 522; Wieger, 1 in 519; Kleinwächter and Galabin state 1 in 500, and Kormann 1 in 600; Corson¹ met with 10 in 3036 cases of labor, or about 1 in 300. According to the statistics of the Philadelphia Board of Health, there were in the five years from 1880 to 1884, inclusive, 100,935 deliveries, and 94 cases of death from eclampsia: supposing that this mortality represented only one-third of eclamptics, the entire number of those affected was nearly 300, or about 1 in 333. The statistics² of the Vienna General Hospital, 1881–85, include 15,070 deliveries, and the entire number of cases of eclampsia was 46, or 1 in about 305.

It is much more frequent in primiparæ than in multiparæ: 28 out of 33 were primiparæ (Hecker); Löhlein in 103 cases of eclampsia found 88 who were pregnant for the first time, or 85.4 per cent.; and Winckel, in 683 eclamptics there were 426 primiparæ, or 77 per cent.

Eclampsia is much more frequent in the last than in the early months of pregnancy, though it has occurred in the first. Coming on after labor, the interval is usually only a few hours, but it may be several days. Bailly, for example, saw a case twenty-nine days, and Simpson one four weeks, and Baudelocque one six weeks, after delivery.³

PREMONITORY SYMPTOMS.—Eclampsia rarely comes unheralded, and the most frequent of its forerunners are headache, disturbance of vision, and epigastric pain. The headache is usually frontal, in some instances lateral instead of general; very rarely it is occipital. Ham-

¹ *New York Medical Journal*, May, 1886.

² *Wien. med. Woch.*, 1886, p. 1209.

³ Kormann, while stating that eclampsia in childbed usually occurs within the first two days, adds that it has been observed as late as eight weeks after delivery.

ilton referred to this frontal pain as especially characteristic. It is at first not continuous, or at least it remits if it does not intermit; when it is constant the convulsive attack is at hand. Associated with the pain in the head, if this precedes the attack some days, there may be some mental disorder, usually simply dulness of intellect or a generally apathetic condition. Disturbance of vision is observed in very many cases. This at first is usually indistinctness of sight or inability to use the eyes for any length of time. But there may be amblyopia, or even amaurosis. In one case of fatal eclampsia occurring at four months of pregnancy which I saw there was almost total blindness for two days before the seizure. Epigastric pain is less frequent than either of the other symptoms that have been given. It is not constant, but while it occurs it may be of such severity that the patient cries out or groans with the distress, and leans her body forward to relax the abdominal muscles. Dyspepsia, nausea, and vomiting may precede the attack. Other premonitory symptoms that have been observed are dizziness, mental depression, stertorous breathing at night, œdema of the face and hands, especially noticeable upon first rising in the morning, and a decided diminution in the urinary secretion.

THE ATTACK.—After a longer or shorter duration of at least some of the premonitory indications which have been mentioned as occurring in most cases, the convulsive manifestations occur suddenly. While these manifestations strikingly resemble an epileptic seizure, they are not preceded by a cry. The patient, lying in bed, may have been conversing, but suddenly she ceases to speak or to listen; her face is immobile as that of a statue, and her eyes are apparently fixed upon some distant object: this is the complete and brief calm preceding the terrible storm. That storm begins with quick movements of the muscles of the eyelids, then of the nasal alæ, and then of all the muscles of the face. The muscles of the upper limbs are next involved, and afterward those of the trunk. Irregular movements of the eyes occur, and then the balls are half hidden behind the upper lids; the face is turned slowly toward one shoulder, and then a reverse movement is made toward the other; the mouth is distorted, and with the swollen and livid face—every mark of intelligence or beauty for the time blotted out—makes a picture that is most painful to the observer, even if not actually repulsive. The tongue may protrude between the half-open jaws, and more or less bleeding occur from its being bitten. Tonic convulsions are first in order, and then clonic, but the boundary-line is not always clear. During the former the body is rigid, and may be arched as in opisthotonos; the upper and lower limbs are stiff, and usually extended, but the thumb is flexed upon the palm and the fingers contracted over it. Co-ordination of respiratory movements is impossible, and from the arrest of respiration, together with compres-

sion of the jugular veins, the face becomes more or less deeply cyanosed: the cyanosis would be general if it depended upon the former cause alone. "Soon tonic convulsions are followed by clonic movements, and to the general rigidity of the preceding period there succeed abrupt movements involving the head, the trunk, and members." Respiration, hitherto suspended, returns, but it is at first stertorous; in some instances the inspirations are shallow, but in others deep; at each expiration frothy saliva and accumulations of bronchial secretions, often flecked with blood from the bitten tongue, are discharged, and fall in spray upon the clothing which covers the patient's chest. The pulse is full and strong at the beginning of an attack, but with its progress becomes frequent and feeble. Whether the muscles of organic life are affected by convulsive movements is not conclusively determined. If they are, it is easy to explain the occurrence of labor and the pains being made more active by the convulsions. Braxton Hicks¹ states that in one case of eclampsia occurring in the sixth month of pregnancy, when an attack of convulsions came on the uterus became intensely firm, and so remained for the space of ten or fifteen minutes without any change, after which it slowly subsided into the ordinary condition of gentle contraction with relaxation. Similar phenomena were observed by him in a second case. Nevertheless, most do not regard uterine action as part of the convulsive attack. During the paroxysm the patient is insensible to the most powerful external excitants: she can neither see nor hear nor feel. Coma or stupor follows the cessation of the clonic movements, its duration being directly proportioned to the severity of the attack. In most cases within half an hour after calm has succeeded convulsion the patient wakes to a kind of semi-consciousness; she looks upon those surrounding her bed, but does not at once recognize them, and when the tardy recognition comes she does not understand the anxiety which their countenances so often express; her face has a sadly bewildered expression; the immediate past is a perpetual blank, and the present a temporary cloud.

In rare cases, possibly, immediate recovery begins, and is complete. But usually eclampsia is not limited to a single attack; other attacks succeed it, the intervals varying from a few minutes to several hours; the attacks may be so rapid, the intervals so brief, that the patient passes directly from coma to convulsion without a moment of even partial consciousness intervening. The coma deepens with each convulsion. Its cause is cerebral congestion resulting from arrested respiration, and impeded return of blood from the head arising from compression of the jugular veins: the congestion may have as its consequence serous effusion, or, though this is rare, an apo-

¹ *London Obstetrical Society's Transactions*, vol. xxv.

plectic effusion. The number of convulsions observed in 135 cases varied from 1 to 81 (Spiegelberg); in one instance Depaul saw 160. The urine is in most cases scanty; in some it is smoke-colored or red from the presence of blood. The duration of the paroxysm varies from two to seven minutes, according to Depaul; Zweifel remarks that we are often deceived as to the length of an attack because of the frightful impression made, and because our attention is absorbed in the battle between life and death, and that occasionally, watch in hand, he has observed some of the longest attacks, and found none exceeding two minutes.

Another source of error, as pointed out by Depaul, is the fact that in some cases the convulsions are so close together that their boundary-line is not distinguished. An increase in the temperature is a constant characteristic of eclamptic convulsions; this is an important fact with reference to diagnosis and prognosis. Bourneville,¹ as the result of six years' study of the temperature-changes in eclampsia, has arrived at the following conclusions: There is a very striking contrast between the thermometric curve of temperature of puerperal eclampsia and that of uræmia. At first there is a fall in the latter and a rise in the former. In the curve of uræmia the temperature² falls progressively, while in the course of the eclamptic condition it rises abruptly and rapidly with the occurrence of attacks. These differences are more and more striking at the approach of death: in uræmia the temperature falls much below the normal, while in eclampsia, on the other hand, it reaches a very high figure—109.4° Fahr.

TERMINATION.—MATERNAL AND FŒTAL MORTALITY.—PROGNOSIS.—The great majority of cases of eclampsia recover; nevertheless, in a considerable proportion a fatal result occurs. Death may occur during an attack from sudden asphyxia "if the stage of tonic convulsions and the suspension of respiration are prolonged beyond half a minute." However, such occurrence is rare. Cerebral hemorrhage, though less infrequent, is also the cause of death. Rupture of the uterus was regarded by Cazeaux as one of the modes in which death might occur; but this rests upon the unproved hypothesis that the uterine muscle participates in the disordered movements of the muscular system of animal life. Death may result from cerebral congestion, from apoplexy, or from meningitis, and also from pulmonary congestion or apoplexy. The most frequent cause of death is a gradual asphyxia, coma becoming more profound and hæmatisis more and

¹ *Archives de Tocologie*, tome ii.

² Wood, in his recent work upon *Nervous Diseases*, after referring to the investigations of Bourneville, remarks: "I am, however, doubtful whether the temperature *always* falls in true uræmia. I have certainly seen it rise in coma occurring in persons suffering from contracted kidney and apparently uræmic."

more imperfect. Bailly mentions an instance in which the tongue was so severely bitten that ligature of the lingual artery was necessary for the arrest of the hemorrhage, and, neglecting this, a fatal result might have followed. He also refers to an instance in which the tongue was bitten, and such great swelling followed that the organ filled the buccal cavity and the pharynx, causing a rapidly mortal suffocation. According to Depaul, about one-fourth of women attacked with eclampsia who die perish from a consecutive puerperal affection.

The maternal mortality is given by Hecker¹ as 27 per cent.; by Dohrn, 29 per cent.; by Hugenberger, 35.1 per cent.; Löhlein, 37.7; Depaul, 50 deaths out of 132 cases. Probably the maternal mortality is in general about 30 per cent. In the majority of those who do not die recovery is complete, but in others some disorder of intellect or of sense may remain for a greater or less time; in some cases there may follow serious renal disease or puerperal mania or paralysis.

The fetal mortality is about 50 per cent. The death of the fetus is to be attributed to asphyxia, the placental circulation being interfered with and the maternal blood being deficient in oxygen; possibly, the poisoned condition of that blood may be destructive to the life of the fetus: another cause is in the high temperature of the maternal blood.

The PROGNOSIS as to the mother—and her salvation is often that of the child—will depend upon the frequency and the severity of the attacks; upon the degree of the disturbance of the renal function; upon whether the temperature still continues to increase, or, on the other hand, is declining to normal; upon the coma being slight or deep and prolonged; upon the readiness with which the uterus can be emptied without violence; and upon whether the patient is suffering from cardiac or pulmonary disease. The prognosis will depend upon when the convulsions occur: if before labor, it is much graver than if during labor, while attacks beginning after delivery are not usually fatal. Thus, Depaul states that of 16 women attacked after labor only 2 died. Galabin says that in the Guy's Charity the mortality was 50 per cent. in cases which began before the onset of labor, 25 per cent. in those which began during labor, and only 8 per cent. in those which began after delivery, the total mortality being 25 per cent.

Charpentier gives the following statistics in illustration of the fact that the prognosis is affected by the number of attacks: The mortality in 45 women, having from one to ten attacks, was 11, or 25 per cent.; in 31, having from ten to twenty attacks, was 10, or 33 per cent.; in 24, having from twenty-one to fifty attacks, was 12, or 50 per cent.

ETIOLOGY.—Lever² in 1842 pointed out the close connection between

¹ These statistics, except those of Depaul, are quoted from Hecker's report.

² Barnes' *Lumleian Lectures*, 1873.

albuminuria and eclampsia; he went so far as to assert that the former always induced the latter, and, conversely, the latter never existed without the former. Admitting the toxæmic origin of the disease, the question as to what was the toxic substance naturally arose. The first answer asserted that it was urea, so that the term uræmic applied to the convulsions seemed eminently proper. This theory, however, was soon cast down, for observation showed that uræmic accidents failed when the blood was charged with urea, and on the other hand occurred when the blood contained but a small quantity: still more, the injection of urea into the blood of an animal did not produce any of the so-called uræmic symptoms. The meaning now attached to "uræmic"¹ points to alteration in the blood caused by the retention in it of products of disassimilation normally eliminated by the kidneys. Frerichs suggested that instead of urea itself being the offending body, it underwent decomposition, and the resulting carbonate of ammonia was the pœccant matter; hence the convulsions were ammoniæmic. Chemists have disputed the possibility of this transformation in the blood; it has been proved too that carbonate of ammonia is normally present, and that its injection into the blood of animals is not followed by eclamptic phenomena. According to a third theory, it is not one element, but the various extractive matters, creatin, creatinin, etc., which with urea are retained in the blood; hence the term "urinæmic" has been applied to the convulsions. Peter says the pregnant woman attacked with eclampsia is urinæmic. It is because there is an accumulation of all the elements of the urine in the blood that she suffers with the final accidents known under the name of eclampsia.

But, without further discussion of this point, it may be admitted that in consequence of renal failure a toxic element is circulating in the blood, and by this poisoned blood the brain and nerve-centres are brought into an irritable condition, which, reaching a certain degree, an explosion in the form of convulsions occurs.

The next object sought was an explanation of why renal disease occurred in pregnancy. The first answer was that the gravid uterus pressed upon the inferior vena cava, upon the iliac veins, and upon the kidneys, and as a consequence there was passive congestion of these organs. Although this view has recently been supplanted by that of Halbertsma, which attributes the renal disease to pressure of the gravid uterus upon the ureters, and which will be presented in a moment, yet it has been sustained in an able article by King: his views are presented below.²

¹ Labadie-Lagrave.

² Dr. King holds that premature descent of the foetal head in the pelvis causes pressure upon blood-vessels and eclampsia—that the head of the child until the near approach of labor normally rests upon one of the iliac fossæ; and he states that the

Halbertsma's¹ hypothesis is, however, that which now rallies the greater number of supporters. The pressure of the gravid uterus is upon the ureters; these are drawn upward by the enlarging uterine, their area being thus increased, and they are not only stretched, but variously flexed and compressed, and thus their permeability is in a variable degree lost. The consequent urinary stasis causes alteration in the renal tissue, unless the stasis be brief: the urine does not contain albumen if the obstruction of one of the ureters is not complete from the onset. If other abdominal tumors rarely cause renal lesions, it is because they are not developed, as the uterine tumor is, between the ureters. He states that even slight pressure upon a ureter will arrest the flow of urine; the experiments of Ludwig upon dogs have demonstrated that the secretory tension of the kidney is very feeble. As is well known, a scanty secretion of urine is one of the most constant forerunners of eclampsia. Leyden has shown from a study of the kidneys of women who died from eclampsia that the changes in these organs are not characteristic of venous stasis, but a simple fatty degeneration of the epithelium. If convulsions are so frequent in the puerperal form of Bright's disease, it is particularly under the influence of the excessive tension to which the urine accumulated in the pelvis is subjected: this tension, too, is exaggerated when the uterus contracts, for there is then a renal hyperæmia compensating for the uterine anæmia, but this temporary hyperæmic condition of the kidneys increases the secretion, and thus the injurious effect of the stasis.

Zweifel, after referring to the investigations of Halbertsma, continues "leading obstetric authorities of the present day tell us it is proper, customary, and normal for the head of the child to present, and even descend below the brim into the pelvic cavity, in primiparæ, two or three months before labor." (See paper in *American Journal of Obstetrics*, 1887, and remarks in *Transactions of the American Gynecological Society*, vol. xii. p. 236.) Dr. King also maintains that convulsions scarcely ever occur in cases of shoulder- or cross-presentation in primiparæ or in multiparæ.

The argument is weakened by the fact that while eclampsia is four times more frequent in primiparæ than in multiparæ, shoulder presentations are between seven and eight times more frequent in the latter. The theory fails to explain the occurrence of eclampsia prior to the latter months of gestation; it fails too to explain why so many primiparæ escape the disease; and it alleges an earlier descent of the presenting head into the pelvis than is generally taught. In regard to the latter point, Depaul, referring in general to this change as one of the precursory phenomena of labor, remarks: "It may take place two, three, or four days before delivery; on the other hand, it may be present at the beginning of the ninth month and even before." Tarnier says, "eight or fifteen days before labor." Moreover, why does excessive distension of the uterus, as from pluriparous pregnancy, create liability to eclampsia? How, too, explain those cases in which pelvic deformity prevents normal descent of the uterus, for here too there is increased liability? A Dublin obstetrician (*Dublin Journ. Med. Sci.*, Sept. 11, 1843) says that there is little fear of eclampsia if the child does not present by the head.

¹ *Revue méd. de Louvain*, 1883.

ued by Löhlein, states in reference to dilatation of the ureters, to which Halbertsma first called attention, that the compression must have lasted for a long time in order that the ureters should become as large as the finger: a temporary and rapidly-disappearing compression could not possibly cause such increase in size; now in only 8 cases out of 32 was there such dilatation.

But there are very serious objections to the acceptance of the theory which makes puerperal eclampsia depend upon renal disease exclusively. Probably not more than 1 woman in 5 who has albuminuria during pregnancy or in labor is eclamptic. Again, while the cases of this sort are not frequent, yet a long list¹ of eclamptics who were not albuminurics has been collected. It is therefore certain not only that renal disease is very far from being a constant forerunner of puerperal convulsions on the one hand, but that its absence on the other hand is no certain proof that such convulsions will not occur. Furthermore, as showing the unsatisfactoriness of our knowledge as to the essential cause of eclampsia even in those cases where the disorder is clearly dependent upon renal failure, the symptoms by no means correspond with those observed in what is known as uræmic intoxication. In the latter the patient is free from periodic attacks of convulsions; the coma constantly increases; there are no intervals of returning consciousness; and the temperature, instead of rising, falls: "a remission of the symptoms is only possible when the impediment to the elimination of urine disappears."

In some instances disease of the brain has been found the cause of the eclampsia. But in a still larger number, though small relatively to those dependent upon renal disease, the convulsions arise solely from reflex irritation. The centre of this irritation is usually the uterus, but in some instances the source is another organ—the bladder, for example. La Motte² has recorded a most instructive case where a woman seven months pregnant had violent convulsions; the abdomen was so large he could not at first believe that her pregnancy was not at its normal end. Learning she had passed very little urine for some days, and that it escaped drop by drop, he attempted to use a catheter, but, finding resistance, he introduced his finger into the

¹ In Trousseau's *Lectures on Clinical Medicine*, Sydenham Society's edition, vol. i. p. 364, there is reported a case of post-partum eclampsia: the urine was repeatedly examined, and neither heat nor nitric acid ever gave rise to the least albuminous cloudiness.

Brooks (*London Lancet*, May 1, 1886) reports a case of eclampsia beginning two days before, and continuing six days after, delivery, without the urine being albuminous. This patient had right hemiplegia coming on slowly after a very long convulsion, and gradually disappearing after a few days: the hemiplegia was thought to be caused by a small hemorrhage in connection with the internal capsule of the opposite side.

² Observation ccxx.

vagina and ascertained that the resistance was caused by the head of the fœtus, which was pressing upon the neck of the bladder. He states: "I gently pushed the head as high as possible, and the moment the neck of the bladder was relieved of the pressure and the urine could have free exit there escaped such an amount that it was impossible to believe the bladder could contain such a quantity or that it could be so greatly dilated without rupture." The simple evacuation of the urine cured the convulsions, which before had threatened a fatal termination. Portal and other obstetricians have made similar observations. A case less conclusive than La Motte's, for other remedies were used before catheterization was employed, in which the convulsions were caused by accumulation of urine, has recently been reported by an American physician. The woman was attacked a few hours after delivery, and first veratrum viride was given in heroic doses without benefit; then chloral was twice given, first hypodermically, and the second time by the rectum; after the last dose the bladder was examined and more than "a gallon of urine" drawn. One with the knowledge of La Motte's case before him would probably have begun the treatment with the use of the catheter, and then possibly no other measure would have been necessary: in neither was there a convulsion after the bladder was emptied.

Dolérís and Butte¹ have found soluble toxic ptomaines in the blood of the eclamptic, which they believe may be the cause in some cases of the disease. It remains to be seen whether this discovery proves to be the essential cause in any considerable number of instances. But, as they claim, it enables us to put aside the exclusive idea of renal insufficiency, spasm, compression, old lesions of the kidneys, etc., and the purely nervous theory. Furthermore, it sustains the conclusion that eclamptic like epileptic convulsions do not depend upon a single cause.

If irritation of the bladder may be the exciting cause of eclampsia, how much more may the disorder arise from uterine irritation! Of course in this age, in which so many of the ills to which human flesh is heir to are attributed to microbes, it is not surprising that the microbial origin of eclampsia should be suggested.² Malcolm Black³ refers to a case in which eclampsia was caused by half an ounce of fluid extract of ergot administered for hemorrhage: he adduces this case to sustain the theory that the convulsions result from a toxic agent in the blood.

Barnes⁴ presents the following summary of his views as to the etiology of eclampsia: "Several conditions concur to cause the associated disorders. These are—(1) the hydraemic state of gestation leading to

¹ *Nouvelles Archives d'Obstétrique et de Gynécologie*.

³ *Glasgow Medical Journal*, March, 1887.

² Debou, *Lyon Méd.*, Oct., 1884.

⁴ *Op. cit.*

imperfect nutrition of the nervous centres, increasing (2) the normal nervous tension and irritability and (3) the normal vascular tension; with these comes (4) blood-poisoning from imperfect elimination of waste stuff by the kidneys and other emunctories."

So far as positive statement can be made of the etiology of eclampsia, there is no single cause. In most cases the disease results from toxæmia, the poisonous agent not always the same, but usually, in all probability, uneliminated organic constituents of the urine. But eclampsia may also be the expression of disease of the brain or of reflex irritation. The conclusion of Löhlein can be accepted, that no explanation of eclampsia has been fully established, and the disease certainly has more than one cause.

Our obstetric masters a generation or two ago looked upon cerebral or cerebro-spinal congestion as the cause, and, the theory admitted, the propriety of depletion was obvious. Dewees, as many in his day, taught that puerperal convulsions were epileptic, apoplectic, or hysterical, and, a strong determination of blood to the head being a premonitory symptom, he at once bled, purged, and put the patient on a low diet. Meigs asserted that the disease was caused by long-continued or violent determination of blood to the head, and Hodge, that in a large proportion of cases it resulted from congestion of the blood-vessels of the brain or from an actual effusion of serum or of blood into its substance or cavities. But now it is generally held that cerebral congestion is the consequence, not the cause, of eclampsia. A directly opposite theory was proposed in comparatively recent years—that known by the name of Traube-Rosenstein. According to this, the eclamptic patient being hydræmic, increase of arterial pressure causes serous effusion, and this effusion compressing the cerebral vessels, acute anæmia of the brain results. Convulsions are the consequence of anæmia of the bulb, and coma of anæmia of the encephalon. If this theory were true, eclampsia ought to be much more frequent, for an hydræmic condition is not uncommon in pregnancy; moreover, in cases of excessive hydræmia, that condition termed by Stoltz and his followers a serous cachexia, eclampsia is not common. No one who holds this theory could resort to depletion in the treatment, for thereby the hydræmic condition would be aggravated.

TREATMENT.—If a pregnant woman suffers from albuminuria, and especially if the urine is scanty, the administration of diuretics and restriction to a milk diet would be indicated. In this condition, too, pilocarpine has been found a useful remedy; a bath, the water being at a temperature of 98° to 100° Fahr., followed by drinking a glass of hot water and the use of other means to promote perspiration, will often prove very useful. Of course a daily free evacuation from the bowels should be had. Moreover, if we admit Halbertsma's theory

of pressure upon the ureters as the cause of the renal disease, the woman ought to lie as little as possible upon her back, and indeed spend a part of the time each day in the genu-pectoral posture, thus relieving the ureters from pressure by the uterus.

But when a convulsive seizure occurs, whether in pregnancy or in labor or after it, curative treatment must be employed promptly. The first question for the practitioner to determine in the presence of puerperal convulsions is as to whether they are toxæmic or reflex. The use of the catheter will almost certainly give the answer, for renal disorder will reveal itself by scanty and albuminous urine, and on the other hand a profuse evacuation of normal urine will testify such disorder is not present, and possibly, too, prove that a distended bladder has been the cause of the eclamptic attack. During the paroxysm the patient should be kept from injuring herself, but efforts to restrain the convulsive movements, though kindly meant by friends, are useless and injudicious kindness: the most that should be done is to prevent her falling from the bed if she chances to be near its edge, and to prevent her biting her tongue; the latter is best accomplished by means of a suitably folded towel or napkin drawn firmly between her jaws and strongly held at each side, so that protrusion of the tongue is prevented.

After the paroxysm is over, except in case the attack comes after labor, bleeding to depletion is indicated if the pulse be full and strong and there are marked evidences of cerebral congestion. A stimulating injection, as of salt and warm water or turpentine with castor oil, may be given. But the most important treatment after the bleeding, if this has been thought expedient, is the administration of chloral: this agent lessens arterial pressure and reflex excitability and lowers the temperature, and therefore clearly meets the indications presented by eclampsia. It may be given by rectal injection, thirty to forty grains, for example, being rubbed up with the yolk of an egg, and a few ounces of milk added. The injection may be repeated, if necessary, in an hour. Some practitioners have successfully used much larger doses at a time—for example, a drachm and a half, or even two drachms, and in twenty-four hours two hundred and fifty, or even three hundred, grains have been given. Chloroform is given by inhalation, the quantity being small during the interval, but rapidly and freely increasing it at the first threatening of another paroxysm. If the patient can swallow, an active hydragogue cathartic may be given by the mouth—compound powder of jalap or elaterium, for example. In case she cannot swallow, a drop or two of croton oil may be put upon the tongue. Spiegelberg has given caution against chloroform narcosis immediately after venesection, because of the danger of too great lowering of the blood-pressure, for then it may cause death;

nor after having begun the use of the anæsthetic is it to be continued if the pulse becomes small and weak.

Morphia is a remedy which has been regarded with very great favor by some. In this country Dr. Clarke¹ of Oswego has especially advocated it. He directs giving to the eclamptic patient at once a hypodermic of one grain and a half; the dose is repeated after two hours if another paroxysm occurs, and if the patient be in labor another dose is given at the end of eight hours. Most practitioners do not employ such heroic doses. Zweifel regards the morphia treatment as especially adapted to cases where the attacks occur at long intervals. It or chloral would be used in preference to chloroform in eclamptic attacks occurring after labor. Professional attention to *veratrum viride* in the treatment of eclampsia was first directed by Fearn of Brooklyn in 1871, and since then testimony to its value has been given by many American practitioners, more especially in the South and West. One of the most recent contributions to the subject is by Jewett,² and the following are his directions as to dose, mode of administration, etc.; he uses the fluid extract of *veratrum viride* as prepared by Squibb, and he rejects administration by the mouth: "The average dose should be from ten to twenty minims. The smaller dose repeated in half an hour will doubtless suffice in the majority of cases. Yet I have usually preferred to place the patient at once fully under the influence of the drug. The guide to the dosage is the frequency of the pulse. Experience seems to justify the statement that no convulsion will occur while the patient is sufficiently under *veratrum* to hold the cardiac pulsations below sixty to the minute. The average time required to develop the full effect of a single subcutaneous injection is thirty minutes. If the desired result is not attained after that interval, the injection should be repeated in the same or smaller amount as may be required. Five-minim doses at longer intervals will suffice to maintain the diminished pulse-rate. I have rarely repeated the drug, however, after the circulation has been once brought profoundly under its effects, the total dosage seldom exceeding twenty to thirty minims of the fluid extract."

The value of pilocarpine has been attested by numerous practitioners. The remedy is administered by hypodermic injection; some have employed one-third or one-half a grain at a time, while others one-sixth at intervals of two hours. Zweifel does not seem to attach much value to it, and, as others have done, warns against its use in threatened pulmonary œdema. Hot baths have been especially commended by Breus, and the results in his hands were very satisfactory. Inhalation of oxygen has been employed, but not with striking success:

¹ *American Journal of Obstetrics*, 1880.

² *Transactions of the American Gynecological Society*, vol. xii.

even if the results had been more satisfactory, the difficulty of promptly obtaining and using the remedy would forbid its general use. Nitrite of amyl has been recommended on theoretical grounds, but there are no clinical proofs of its value.

It may be said in general as to specific methods of treatment, whether by these or by any other means—*e. g.* bleeding, chloral, or veratrum viride—that it is only by the sum of many observations the truth is obtained: individual experiences may grossly mislead, for the cases themselves differ so greatly in their gravity, and it is necessary “in determining the value of remedies to carefully discriminate, individualizing the cases.”

Obstetric Treatment.—If labor has come on, it is the obstetrician's duty to deliver as soon as possible, abstaining, however, from all violence. But if the convulsions occur in pregnancy, no uterine action being present, the question as to the induction of labor is presented. The objections to bringing on labor are that in some instances the convulsions cease and the gestation continues to the normal period, and that the induction of labor adds to reflex irritation: under this increased irritation, and considering the length of time which in some cases must elapse before the uterus can be emptied, the patient may perish before its accomplishment. Each case must be determined by itself; it is only after the failure of well-advised therapeutic means to control the eclamptic attacks, and with a reasonable hope of averting otherwise inevitable death, that the induction of labor is advisable.¹

INJURIES TO THE CHILD DURING BIRTH.

These injuries, whether occurring in natural or in artificial labor, may be conveniently divided according to the parts of the child upon which they are inflicted. Thus, the first class will include Injuries of the Head and Neck, the second those of the Trunk, and the third those of the Upper and Lower Limbs.

INJURIES OF THE HEAD AND OF THE NECK—(a) *Caput Succedaneum.*—This, designated by Depaul sero-sanguineous infiltration, is a common but not a constant phenomenon of childbirth: if the labor is

¹ Pajot very positively condemns the induction of labor, “for this requires quite a long time. Thus in fifteen cases at the Clinique last year in which labor was induced for various causes, the mean duration of the beginning of labor was eight to ten hours. But many times the period of time necessary to bring in play the uterine forces is much longer. Now, in very many cases eclampsia is determined within fifteen, eighteen, twenty-four hours” (*Arch. de Toccol.*, 1885). Considering that the disease itself tends to induce labor, probably the time necessary to excite uterine action is not so long in eclampsia as Pajot suggests. Moreover, by means of Barnes' dilators the duration of labor may be reduced to a very few hours.

rapid, little resistance offered at the os uteri or any part of the birth-canal, and especially if the amnial sac is not ruptured until a short time before delivery, there is no swelling upon the part of the child which presents. The cause of the formation of the caput succedaneum is the absence of pressure upon that part of the child which is immediately in the free portion of the birth-passageway, while all other parts are being subjected to severe pressure. As long as the waters are retained this swelling does not occur, or at least, if occurring in rare instances, it can only be very slight. Mauriceau attributed the caput succedaneum to the constricting os uteri acting as a ligature in preventing the return of blood and serum forced into this part of the head by uterine contractions—a view which Depaul regarded as presenting some truth.

While the tumor is usually developed during the dilatation of the mouth of the womb, and is then known as the primary caput succedaneum, it may also be formed at some other part of the birth-canal, when, the previous one having appeared, this is called a secondary one. In case of narrow pelvis, for example, the great difficulty in the expulsion of the child and the consequent slowness of the labor, the caput succedaneum is usually very large.

In most instances the swelling disappears in a few hours or in a few days after birth. Exceptionally, especially if rude or frequent “touching” has been employed, the surface of the tumor presents phlyctenulæ, which upon rupturing leave superficial ulcerations which may not heal for several days, or they may be starting-points of erysipelas or even of gangrenous inflammation. In still other instances phlegmonous inflammation of the tumor may occur, and this inflammation end in suppuration.

TREATMENT.—The great majority of cases of this sero-sanguineous infiltration require no treatment: if the swelling in any instance lingers, its disappearance may be hastened by the application of alcohol and water or of a solution of muriate of ammonia. Raw surfaces may be dusted with iodoform or boracic acid after they are thoroughly cleansed. Should suppuration occur, the treatment is the same as that of external abscesses appearing elsewhere.

(b) *Kephalohæmatoma or Thrombus Neonatorum*.—By this name is designated an effusion of blood between the periosteum and the bone, usually situated upon one of the parietals, upon the right more often than upon the left, but in some cases upon both, and in rare instances upon the frontal, the occipital, or upon one of the temporals. True kephalohæmatoma should not be confounded with the affection previously described, which by some authors is called kephalohæmatoma spurium.

The cause of this affection is by no means certain; to say that it is

traumatic gives no explanation, for the cause of the traumatism is unknown. Godson¹ asserts that kephalohæmatoma is "most probably due to the constriction of the os during labor;" and Earle² attributes the majority of cases to this cause, though he correctly states that the affection has been observed after a pelvic delivery: in reference to the latter Bastaki³ has recently reported an instance of it. The explanation adopted by Godson and Earle is without foundation: when we remember that the affection is not frequent, it is quite probable that it occurs relatively quite as often after pelvic as after vertex deliveries. Mildner⁴ and Hecker held that the blood-effusion resulted from the coats of the blood-vessels being thin and easily ruptured, while Langenbeck and Ritter attributed it to the defective development of the external table of the bone.

The fact that a kephalohæmatoma having all the characteristics of the affection in the newborn may occur in children some years old is a conclusive argument against the hypothesis of a traumatism in labor.

FREQUENCY AND SYMPTOMS.—While most authorities speak of the affection as quite rare, Kleinwächter gives the proportion of 1 to 200–250. Kephulohæmatoma is rarely seen immediately after birth, but in most cases a period of one to three days intervenes before the swelling, which varies in size from a pigeon's egg to that of a small apple, makes its appearance. The tumor is elastic, fluctuates, the fluctuation being more distinct than that observed in case of an abscess, is without pulsation, and there is no increase in its size when the child is crying; the color of the skin covering it is not changed, presenting in this regard a marked contrast with the appearance of a caput succedaneum; and usually a bony margin surrounding the base of the tumor can be felt, but if the tumor is apparent at birth this osseous elevation will not be discovered until a few days have passed. Kleinwächter states that the swelling never goes beyond a suture or fontanelle, and when it is double there can always be felt an intervening suture or fontanelle. Bouchut,⁵ however, asserts that while the effusion seems limited by the sutures, nevertheless it may cross over and extend from one bone to another; he also quotes the remarkable case of Duerest, in which the effusion beginning upon one parietal bone extended to the biparietal suture, passed over it, then beneath the opposite parietal, between this bone and the dura mater.

PROGRESS.—In rare cases the swelling disappears in ten or twelve days, but in others it may remain for a month. In some instances

¹ Quain's Dictionary.

² Journal of the American Medical Association.

³ Archives de Tocologie, September, 1888.

⁴ See Kleinwächter's article on Kephulohæmatoma, *Real Encyklopædie der gesammten Heilkunde*.

⁵ *Traité pratique des Maladies des Nouveau-nés, etc.*

suppuration occurs, and this may be followed by caries of the bone. If the affection is complicated by an internal kephalohæmatoma—that is, by an effusion between the dura mater and the bone—the child will be affected by convulsions and paralysis, and death result.

TREATMENT.—Evacuating the collection of blood may hasten the cure, but this operation is objected to on the ground that infection of the wound may occur, and then greater danger to the periosteum results. Most practitioners, knowing that spontaneous cure is the rule, advise a temporizing course, and would not resort to incision unless the tumor remained of undiminished size for some time or unless suppuration occurred. Nevertheless, it is possible good results would be had from careful antiseptic aspiration of the tumor.

(c) *Wounds of the Scalp and of the Face.*—These injuries of the scalp may be contused, punctured, or lacerated, while wounds of the face are usually contused. Probably contusions are most frequently caused by the blades of the forceps, either because of their wrong application or because the instrument itself is badly constructed. As a rule, the blades of the forceps should be applied to the sides of the child's head, but in some instances such application is impossible. Another rule which ought to be regarded as golden is that the compression directly made by the instrument must be only sufficient to prevent slipping; but this rule is sometimes neglected, and the consequence may be more or less injurious. Nevertheless, the contusions directly caused by the forceps are generally quite superficial, and in a few days disappear. An antiseptic lotion may be applied twice a day.

Injuries to the eyes have been produced in face presentation by careless or rude touch: the fact ought to be sufficient to guard against the accident.

Punctured and incised wounds of the scalp have been made by the obstetrician in consequence of his mistaking the caput succedaneum for the bag of waters. Tarnier gives an instance of such a wound being the origin of a fatal erysipelas. In every case where the practitioner is in doubt in making the differential diagnosis let him pass one or two fingers above the swelling, so that he can directly touch the bones of the head, and then the difficulty will be removed.

A lacerated wound of the scalp has been caused by one of the blades of the forceps being thrust between the scalp and the cranial bones. Charpentier reports a case of this blunder, and I have met with a similar one, the attendant stating that he could apply one blade of the instrument very easily, but in attempting to introduce the other there was an obstruction caused by the head being attached to the uterus.

Sloughing of a portion of the scalp has been observed following some cases of spontaneous labor. Thus, Priestley¹ has reported a case of this

¹ *London Obstetrical Society's Transactions*, vol. i.

kind resulting in death eight days after delivery : the labor was protracted for forty-eight hours because of a narrowed pelvic outlet. Lizé¹ of Mans states that in the case of a multipara forty years of age the bag of waters ruptured five days before the birth of her child, which presented by the vertex, but occupied an occipito-sacral position. Five days after delivery a slough involving almost the entire extent of the occipital bone appeared ; three days subsequently it became detached and the child recovered. Bouchut² quotes from Lorain a case of gangrene of the scalp in a newborn child occurring in the service of Moreau. The mother was a primipara, and the labor lasted forty-eight hours, terminating spontaneously ; the child died on the nineteenth day. Dr. Goodell informs me of a case in which an oblique application of the forceps was made—one blade being in relation with the right frontal bone, and the other with the left occipital—and the right anterior portion of the head was so bruised that sloughing occurred a few days after birth : after the detachment of the slough a fatal hemorrhage ensued.

Depressions and fractures of the cranial bones, separation of their union to each other, fractures of the bones of the face, as well as disjunction of their articulations and joints, have been observed more or less frequently in cases of difficult labor, manual or instrumental—some of them, indeed, in spontaneous labor. Some obstetricians have asserted that depressions of the bones of the foetal skull are always accompanied by fractures. This was the opinion of Danyau, of Lachapelle, and of Schroeder. But a case³ given by Matthews Duncan seems to strengthen the view held by most obstetricians, that such depressions may occur without the bone being broken. The case was one in which a persistent impression was made on the right parietal bone by the finger of the accoucheur, who was endeavoring to cause rotation. The result was slight, short, but frequently-repeated epileptiform seizures, which lasted some time after the impression had disappeared, and were finally replaced by choreic movements. It seems hardly probable that the pressure of the finger produced a fracture of the bone.

Dugès⁴ has given an instance of great depression in one of the parietal bones not followed by any serious consequences. The child was delivered by the feet through a pelvis of which the conjugate diameter was estimated at three inches and a quarter. Powerful traction upon the shoulders and upon the lower jaw was necessary to bring the head past the obstruction, and the parietal bone, which was in relation with the sacro-vertebral angle, presented a depression half an inch in depth and two inches in breadth. The infant was resuscitated with

¹ *Annales de Gynécologie*, 1875. ² *Traité pratique des Maladies des Nouveau-nés, etc.*

³ *British Medical Journal*, October 18, 1873.

⁴ Quoted by Jacquemier; *Manuel des Accouchements*, Paris, 1846.

difficulty, then had convulsions, but in a few days was quite well, and in fifteen days the depression had entirely disappeared.

Minor impressions or indentations are sometimes seen, especially after the application of the forceps, and in rare instances such marks are permanent. But we must not be in haste to conclude that these indentations found upon the head of a newborn child are proofs of instrumental delivery, for Oslander¹ has stated that, having delivered a child by podalic version through a narrow pelvis, he found upon its head a depression into which the end of a forceps-blade accurately fitted; so that he himself would have concluded, had he seen a similar depression in another case, that the delivery had not been spontaneous, but by the forceps.

Fractures of the fetal skull have been observed as the result of direct violence, as when a woman expels her child while she is standing and it falls on the floor. Or, again, a woman² near the close of the second stage of labor, the child's head being at the vulvar opening, threw herself out of the window, and several fractures of her limbs, as well as a fracture of the child's head, resulted. But apart from these cases in which the injury has resulted from direct violence and those observed in delivery, whether spontaneous, manual, or instrumental, in narrowed pelves, fracture may occur when the labor is in all respects perfectly normal so far as duration and facility are concerned. Thus, Dr. Charles West³ has reported a case of an infant dying from convulsions nine days after birth, the labor having been an easy one and lasting only five hours. The mother had previously given birth to two living children, and these labors, too, had been normal. Yet at an autopsy of the third child a fracture of the right parietal bone was discovered, with effusion of blood between the cranium and dura mater, the effusion being more than half an inch thick and occupying the entire fossa of the bone. Dr. West states in his report that fractures of the skull have been known to take place during easy labors and wholly independent of any preternatural degree of ossification of the skull. Monteith⁴ mentions having attended a case of perfectly natural labor in which the child had a fracture of the right parietal bone. There was a marked depression in the middle of the bone, and the fracture extended to the sagittal suture on one side and to the coronal on the other. It is quite apparent that a case such as either

¹ Given by Cieslewicz, *Verletzungen des Fetus durch den Geburtshelfer*, Halle, 1870. Cieslewicz has collected forty cases of fracture, fissure, contusion of nerves, laceration of muscles, separation of epiphyses, etc. occurring in labor; he also reports two of rupture of the longitudinal sinus.

² Quoted by Delore: "Fractures du Fœtus," *Dictionnaire encyclopédique des Sciences médicales*.

³ *Transactions of the London Medico-Chirurgical Society*, 1845.

⁴ *London Lancet*, November 14, 1874.

of these might give rise to medico-legal investigation or to unjust censure of the obstetrician.

In regard to fracture of the bones of the cranium or face, or rupture of the joints of the maxillary symphysis or of the cervical vertebræ, or fracture of a vertebra—for it is claimed that usually the body of one is broken rather than two vertebræ separated as the consequence of great traction occurring in manual or instrumental delivery—an important question arises as to the amount of force which may be safely used either with hand or instrument. In illustration of the great force which has been employed in forceps delivery without injury to mother or child I quote the following from Dr. Peugnet.¹ He states: "I was called to Mrs. K——, a multipara, in labor with her third child. The first two were delivered by craniotomy. The vertex presenting R. O. A. and impacted between the sacrum and the pubes, the conjugate diameter of the superior strait greatly contracted, I applied forceps and had great difficulty in locking them. Dreading the laceration which might ensue in this case from side-to-side lever action, I concluded to rely upon direct and steady traction. My strength giving way, her husband held me round the waist, whilst the patient was held *in situ* on the dorsum by four women. In forty-five minutes I had the satisfaction of bringing the head down upon the perineum. The delivery was then speedily accomplished. Both mother and child, a girl, did well." The least that can be said in regard to this case is that the result was very remarkable, and it is doubtful if the practice pursued could be repeated in any considerable number of similar cases without injury to both mother and child.

Delore,² after remarking that the fetal head may endure without injury a great compressing force if applied to a large surface, and if made by a regularly concave surface, as that of the blades of the forceps, states that from his experiments he found a compressing force of 100 kilogrammes (250 pounds) did not cause a fracture. But, on the other hand, if the blades slip, if the pressure is made upon a small surface, fracture follows the exercise of much less force. Further, a blunt, angular body, such as the sacro-vertebral angle, the spherical surface of which is described by a radius of two or three centimeters, produces a fracture with a force of 20 kilogrammes (50 pounds). As the force which is exerted in difficult labor is more than 20 kilogrammes (50 pounds), fracture results. Nevertheless, these results are not in complete accord with those of Goodell,³ though, as will be seen, he is discussing the question of the amount of traction force that may be used in a narrowed pelvis without injury to the neck of the child. Nevertheless, the subject of injury to the bones of the head

¹ *Ohio Medical and Surgical Journal*, 1878.

² *Op. cit.*

³ *American Journal of Obstetrics*, 1875.

is also involved, and in only one instance, I believe, does he mention fracture of one of the cranial bones. He states that he has on several occasions delivered living children after throwing on their necks a weight of 130 pounds. He further says that, although exerting all the manual strength at his command, he has never seen the body part from the head. He mentions one instance in which there was not the slightest apparent injury to the neck though the sacral side of the head had been broken in. Further, in another case the force of traction upon the child's head, combined with suprapubic pressure, amounted to 200 pounds. Stone¹ has more recently reported a case of podalic version and delivery by traction through a narrowed inlet in which he put on the neck of the child all the force of which he was capable, using the pump-handle movement described by Goodell. The child was dead. There was no fracture of the bones of the head. The spine had parted in the upper dorsal region during the traction upon the trunk, which was necessary to cause the shoulders to come low enough to reach the arms. The cervical spine was not broken.

Delore's conclusion as to the amount of force followed by fracture of the cranium of the fœtus is erroneous, or such injury ought to have been observed in all cases where a force even approaching 100 pounds was used. Champetier's² investigations as to the force that could be safely used in the delivery of the fœtus led him to the following conclusions, the first of which does not correspond with the results obtained by Goodell: First, there is danger of fracturing one of the parietal bones, whatever the method of extraction, if the total force employed reaches 35 to 40 kilogrammes (87–100 pounds), the infant being at term; 20 to 22 kilogrammes if it be premature. Second, the inferior maxilla of a child at term will bear, without rupture, a traction of 25 kilogrammes (62½ pounds). Third, the vertebral column of an infant at term was ruptured in three cases by a force of 50 kilogrammes (125 pounds).

If it is objected that these results have been obtained by experiments upon dead children, and therefore are not applicable to the force which may be exerted upon living ones, the answer of Matthews Duncan may be repeated. He, after consulting physiological and physical authorities, could say that a child living and one recently dead were the same as to tensile strength.

In this connection it is well to refer to the amount of traction which may be safely applied to the lower jaw of the fœtus, as stated by Duncan³ from his own experiments. It will be observed that his results are not the same as those announced by Champetier. Duncan states: "It is now ascertained that a force of half a hundred weight (56 pounds)

¹ *Medical and Surgical Reporter*, February, 1880.

² *Du passage de la tête fœtale à travers le détroit supérieur rétréci du bassin.*

³ *London Obstetrical Society's Transactions*, vol. xx.

may, at least in some cases, be applied by dragging the lower jaw of the fetus without producing any easily discovered injury of parts." He further says that compound dislocation would be almost certainly fatal, and in one of his experiments this injury was inflicted by a weight of 56 pounds. Not only does Duncan's statement as to the force which the inferior maxilla will bear without injury differ from that of Champetier, but the difference is still greater than that given by Delore, who makes this 40 kilogrammes (100 pounds).

Fractures of the cranium usually involve the parietal bones, but they may also occur in the frontal, in one of the temporals, or in the occipital bone. Jacquemier first pointed out the separation between the squamous and the basilar portion of the occipital bone, to which some more recent writers¹ have directed attention without giving him just credit. He also stated that he had met with fracture of the occipital bone above the protuberance. Ruge,² referring to separation of the epiphyses between the squamous portion of the occipital bone and the articular part, states that Schroeder is the only one who has recently drawn attention to it; and, notwithstanding its importance in regard to the life of the child, this lesion is not referred to in classic works as one of the immediate consequences of extraction. The lesion may also occur in a narrowed pelvis, though the head present. In these cases there may be not only effusion of blood, but further compression from the squamous portion having its anterior inferior margin forced against the medulla. Lusk³ states that he has seen a quadrilateral depression of the frontal bone following a comparatively easy forceps delivery, and the only cause that could be discovered was pressure of the blade of the instrument.

He also says that in the case of a flattened pelvis, where the head enters in the transverse diameter, it will sometimes happen, if the forceps is used, that the pressure of the blades bears directly upon the forehead and upon the occiput. This will be tolerated for a certain length of time, but when continued the pressure ultimately affects the medulla oblongata. It is then difficult to get the child to breathe, the respiratory sense being destroyed, and often the child is born dead as the result of such pressure. It is always important, therefore, to apply the blades in the oblique diameter if they cannot be applied to the sides of the child's head.

On the other hand, severe injury of the frontal bone has been observed without serious consequences. Thus Dugès⁴ saw a child recently delivered whose left eye was almost completely outside the

¹ Thus Bednar (*Die Krankheiten der Neugeborenen und Säuglinge*, Wien, 1863) refers to it as a hitherto unobserved injury.

² *Bulletin de Thérapeutique*, from *Zeitschrift für Geburtshülfe und Frauenkrankheiten*, 1875.

³ *Medical and Surgical Reporter*, 1887.

⁴ Jacquemier: *op. cit.*

orbit, so great was the depression of the frontal bone; yet the infant did not have convulsions or any other grave symptoms. I have seen protrusion of the eyeball in a newborn child following fracture of the frontal bone by Hodge's forceps in a case of tedious labor in a primipara, the delay being from an occipito-sacral position. The child lived for a week. That an infant may survive very grave injuries in labor is proved by a case reported by Lamotte,¹ in which a surgeon in a case of shoulder presentation had torn away the arm and then performed a craniotomy, evacuating a large amount of the cranial contents; yet the child was born alive.

Zweifel² regards fissures and fractures of the cranial bones as of clinical significance only if a sinus be injured and consequent hemorrhage occur. On the other hand, Delore³ asserts that all these fractures are grave, on the ground that they may be accompanied by contusions of the brain. Further, there may be hemorrhages between the bone and the periosteum, in the cavity of the arachnoid, or between the pia mater and the brain. If the solution of continuity be at the position of a sinus, there is frequently rupture of the vessel. He adds that in all cases in which the head has undergone severe compression from dystocia he believes hemorrhages occur. The significance of this last remark will be appreciated especially when we consider the remote consequences upon the mental condition of the child, as urged more especially by some English observers.

Injuries to the bones of the face are usually of the inferior maxilla. This bone may be fractured or separation of the mental symphysis may occur. Ruge mentions cases in which, in addition to injury of the bone, there were lesions of the soft parts—as, for example, tearing of the skin at the angle of the mouth, as well as of the mucous membrane of the pharynx, and rupture of the genio-glossus muscle. Yet if we fail to use traction upon the lower jaw in cases of difficult head-last labors, we miss what may prove an important means of delivery when other means fail. Some years ago in a case of narrow pelvic inlet, having vainly tried the forceps, I performed podalic version, and sought to deliver by traction, while a consultant aided me with suprapubic pressure. I am confident that I did not use the force which some operators have safely employed under similar circumstances, yet the cervical vertebræ gave way, either by separation or by fracture, and I found apparently nothing but the integument holding the head to the body. I then succeeded by traction upon the inferior maxilla, suprapubic pressure assisting, in bringing the head into the pelvic cavity.

That the head may be left in the uterus, the body being dragged away, is a fact proved by occasional instances in the history of obstetrics. In other cases the division has been made, not by rupture, but by ent-

¹ *Traité des Accouchements*, 1726.

² *Lehrbuch der Geburtshilfe*.

³ *Op. cit.*

ting through the neck. An instance is reported¹ in which the obstetrician, failing to deliver the head in a case of shoulder presentation, after detaching the arm and bringing down the feet, performed decollation, and the head and the placenta remained in the uterus for forty days. Freund mentions a case in which the head was left in the uterus for ten years. In at least two instances, one given by Leishman and the other by Dr. Joseph Price,² the Cæsarean operation has been performed for the removal of the head left in the uterus, the body having been torn away.

Probably the most remarkable case of multiple injuries to the face has been recorded by Petit.³ The face presented, rupture of the uterus occurred, and the woman died undelivered, though the forceps had been used. The autopsy of the child showed multiple separations of the bones of the face and fractures.

Paralysis of one of the facial nerves has been observed most frequently, but not exclusively, after the use of the forceps. In a paper read before the American Gynecological Society in 1885, I referred to eight cases of spontaneous unilateral facial hemiplegia, and also mentioned one case observed by Seeligmüller, in which the paralysis affected both sides of the face. But the disorder usually occurs from the use of the forceps, and is caused by the pressure of one of the blades at the stylo-mastoid foramen or a little in front of the lobe of the ear. Landouzy, who has best described this affection, remarked that in the infant the complete absence of the mastoid apophysis and the slight development of the auditory canal favor compression of the facial nerve near its point of emergence. According to Parrot and Troisier recovery usually takes place in six weeks in paralysis of the facial nerve caused by the forceps. Many cases, however, get well in ten days. Nevertheless, while recovery is the rule, it should be remembered that in some cases the injury is permanent. Duchenne⁴ refers to two patients, one fifteen years old and the other five years and a half, in each of whom the paralysis continued. It should also be observed that there may be facial paralysis in the newborn, caused by protracted labor and intracranial hemorrhage.

Injuries of the sterno-cleido-mastoid muscle have been observed by several practitioners. Torticollis of obstetric origin was explained by Stromeyer and Dieffenbach as resulting from improper application of the forceps, the muscle being bruised or torn. But this explanation is rejected by Saint-Germain as not plausible. A very large proportion of infants that have wry neck are born with pelvic presentation, and it

¹ *Obstetric Gazette*, from *Archiv für Gynäkologie*, March, 1883.

² "System of Midwifery," *Medical and Surgical Reporter*, November 19, 1887.

³ *Annales de Gynécologie*, 1874.

⁴ See Nadaud: *Des Paralysies obstétricales des Nouveau-nés*.

is asserted that the traction asserted causes rupture of some fibres of the muscles; a hæmatoma follows, and finally contraction of the cicatricial tissue results in drawing the head into an unnatural position. One of the first references to tumors of the sterno-cleido-mastoid in the newborn was made by Melchiori¹ in 1862. He spoke of them as indurations of muscle sometimes met with in young infants, and to which he found no reference in authors. He met with this disorder four times, and he described the affection as an indurated plastic deposit. While he mentions temporary deformity of the neck, he does not speak of any case in which this was permanent. In referring to its etiology he suggests that compression of the muscle or laceration of some of its fibres may take place during labor. The next year both Dr. Wilks and Sir James Paget² met with cases of what they described as chronic induration of the sterno-cleido-mastoid. Another case of the affection was reported the same year by Dr. Harris; and thus the published cases in a few months numbered at least six. But no reference was made by any of the reporters to the previous observations of Melchiori.

Bryant³ in 1863 reported two cases of thickening of the sterno-cleido-mastoid. One patient was four, the other eight weeks old, when he saw them. In each instance the birth was with pelvic presentation. Probably in all the cases, or at least in a majority of them, the disease was hæmatoma. Nevertheless, Blachez⁴ regarded these tumors as caused by an interstitial myositis in consequence of traction upon the muscle. He describes the tumor observed in one of his patients as elastic, almost painless, and the size of a pigeon's egg; it was situated in the right sterno-cleido-mastoid, and was not discovered until two or three weeks after birth, when the attention of the parents was called to it by the infant's keeping the head inclined to the right side. Zweifel recognizes injuries of the sterno-mastoid muscle in labor as a cause of torticollis. Professor Albert⁵ of Vienna, referring to a child with torticollis, stated that the sterno-cleido-mastoid may become contracted during intra-uterine life or be injured during birth. In breech presentations and in difficult forceps delivery a laceration of this muscle may occur, and be followed by inflammation and contraction.

While such injury is more frequent after head-last labors, yet it may be met with when the vertex presents and the forceps is used. I have seen one case of this injury in an infant six weeks old brought to the Jefferson Medical College Hospital. From the physician, who came with the mother and infant, I learned that the labor was a very difficult one in consequence of the great size of the

¹ *Medical Times*, London, August 9, 1862.

² *London Lancet*, vol. i., 1863, pp. 11, 236, and 313.

³ *London Medical Times*.

⁴ *Gazette hebdom.*, May 19, 1876.

⁵ *Obstetric Gazette*, September, 1882.

child and the mother being a primipara; the vertex presented, and delivery was finally accomplished by the forceps. A tumor situated just above the clavicle, and apparently in the muscle, could be both seen and felt at the time the child was brought to the hospital; a week subsequently it was much lessened, and I believe soon disappeared, and also there was gradual restoration of the function of the muscle.

Whether the tumor be a hæmatoma or the result of a circumscribed inflammation of the muscle, it gradually disappears, and probably in the majority of cases there is complete recovery of the muscle. Possibly the disappearance of the tumor may be hastened by the application of mild discutients or by slight counter-irritation, but the employment of active means is not indicated.

Injury to the Brain.—On October 2, 1861, a paper was presented to the London Obstetrical Society by Dr. Tyler Smith for Dr. W. J. Little, the title being, "Upon the Influence of Abnormal Parturition, Difficult Labors, Premature Birth, Asphyxia Neonatorum, on the mental and physical condition of the child, especially in relation to deformities."¹ In this paper—which, by the way, mentions two cases of wry neck attributed to difficult labors—the author says: "It is impossible not to connect the persistent affections of the intellect, of volition, and of organic life with the injury the several nervous centres suffered in some instances before the fœtus had reached the maternal pelvis; in others, whilst in transit through it; and in a third set of cases, where the fœtus was exposed to neither of these kinds of injury, it suffered from asphyxia neonatorum, suspended animation and its concomitant congestions, effusions, capillary apoplexies of the brain, medulla oblongata, and spinal cord." Dr. Langdon Down, in discussing the obstetrical aspects of idiocy, stated that in a very large number of cases of idiocy the subjects were born after difficult and unusually tedious labors; and he held that if a neurotic tendency was present the tedious labor and suspended animation might determine the catastrophe, where otherwise all might have gone fairly well.

The following note from one of Dr. Little's² correspondents may be of some interest; it is in reference to a young man in regard to whom inquiry had been made by Dr. Little: "I have again ascertained he was asphyxiated for two hours when born, and that he has always been a weak creature, very slow in mental development, with difficulty in speaking, trembling and shaky, unable to fix his attention on a book, and a bit of a punster."³ These views are further strengthened by the statement of Dr. Arthur Mitchell⁴ that he believes there is a connection between difficult labor and idiocy.

¹ *Obstet. Society's Transactions*, vol. xviii.

² *Obstetrical Transactions*, vol. iii.

³ The final statement, "a bit of a punster," is conclusive as to the intellectual feebleness of this unfortunate man.

⁴ *Medical Times*, 1862, 1863.

Intracranial hemorrhage is one of the rather rare accidents to the child in difficult labor. Dr. McNutt¹ has given 10 cases of this accident: in 7 the child presented by the vertex, and in 3 by the breech; paralysis occurred in all the latter, but in none of the former. The same writer has reported² the case of an infant presenting by the feet, the labor slow, and finally terminated by instruments; convulsions immediately followed the delivery, but disappeared after a few days, being followed by complete paralysis of both sides of the body, not including the face. The child never walked and never spoke; it died of pneumonia at two years and a half of age, and upon the autopsy "atrophy about the fissure of Rolando was present on both sides of the brain." She also has, in a previous paper³ entitled "Intracranial Hemorrhage in Children," given from Dr. Allen Starr the case of a child ten years old who had never walked, and could not stand or sit without support until after it was six months old. Its birth was difficult, instruments being employed, and convulsions followed.

Dr. Hirst⁴ has reported the case of a child dying two days after birth. It was the second of twins, and, presenting by the breech, its extraction was difficult, during which it was supposed the injury causing its death occurred: the autopsy showed a large mass of clotted blood under the dura mater, the hemorrhage having resulted from a rent in the longitudinal sinus.

According to Ross,⁵ in the meningeal hemorrhages of the newborn the children are either born dead or in a condition of asphyxia, and often die soon afterward. If respiration is established, the infant lies in a comatose condition for some days or weeks, and during this time it suffers from frequent attacks of convulsions, which are generally most pronounced on one side of the body. In such cases the disease may prove fatal by coma, or the patient may gradually recover so far as life is concerned, but remain subject to one or other of the forms of spastic hemiplegia of infancy.

It is unnecessary to refer to the treatment of intracranial hemorrhage occurring in birth. It may be questioned whether podalic version and extraction are not attended, considering the history of some of the cases which have been referred to, with greater danger, so far as the brain is concerned, than vertex delivery.

Dr. Wharton Sinkler⁶ states that a very large proportion of the cases of paralysis he has met with in infants have followed instrumental

¹ *American Journal of Obstetrics*, 1885.

² *American Journal of the Medical Sciences*, 1885.

³ *Quarterly Bulletin of the Clinical Society of the New York Post-Graduate Medical School*, vol. i.

⁴ *University Magazine*, October, 1888.

⁵ *Handbook of the Diseases of the Nervous System*.

⁶ *Medical and Surgical Reporter*, November, 1887.

or prolonged and difficult labors. Hemiplegias are often met with in the newborn as a result of the use of the forceps: he mentions having seen a child with right hemiplegia, the mother stating that the child had been delivered with the forceps, and that immediately after birth there was a deep depression behind the left ear: he found upon examination of the child, then sixteen months old, that a depression still existed in the left mastoid process. The right leg was spastic and the movements of the arm limited and inco-ordinate. Spastic paralysis, and what is sometimes called double spastic hemiplegia, very frequently occur in children who have been born by the breech. These conditions generally persist during life, and are associated with a feeble condition of the intellect.

Sinkler also states that in the cases of paralysis following difficult or instrumental labors the lesion is often an extravasation of blood over the motor convolutions—a meningeal hemorrhage. If the amount of extravasation is great, the prognosis is of course bad, but in some of the cases, especially where there is monoplegia, where there is paralysis of one arm alone, the child entirely recovers the use of the limb. Dr. Osler¹ states that the records of the Philadelphia Infirmary for Nervous Diseases contain 9 cases of palsy following delivery with the forceps; in 6 of these cases the child is said to have been injured by the instrument—some of the children, indeed, had scars from the injury—and in all the paralysis was either noticed at once or a few months afterward without definite onset.

INJURIES OF THE TRUNK.—The chief lesions of the trunk are: rupture of the connections between the dorsal vertebræ, or fracture of one of these; injuries to the abdominal wall by a badly-directed blunt-hook; effusion of blood in muscles, similar to those that have been referred to as occurring in the sterno-cleido-mastoid; retroplural hemorrhages along the spinal column in case rupture of this column occurs; hemorrhage into the abdominal or thoracic cavity; collections of blood beneath the capsule of the liver or of the kidneys; and rupture of one or both of the sacro-iliac joints. Ruge has collected 44 cases of injury to the fetus occurring in extraction after version, and 29 of injuries in pelvic presentations. In the former there are 3 cases of rupture of the sacro-iliac joint. It is probable, as suggested by Zweifel, that some cases of ankylosis affecting this joint, of which the etiology is obscure, are to be attributed to injury in birth. Zillner² has reported a rupture of the sigmoid flexure occurring in labor.

Dr. W. H. Parish reports having seen a tear of the perineum in a newborn extending from the vulvar orifice through to the rectum, caused by the tip of one of the blades of the forceps which the

¹ "The Cerebral Palsies of Children," *Medical News*, July 14, 1888.

² *Centralblatt für Gynäkol.*, 1885.

practitioner had attempted to apply to an unrecognized breech presentation.

INJURIES OF THE ARMS.—In connection with these lesions, those of the scapula and clavicle, which belong to the arms rather than to the trunk, will be considered. Delore states that *fractures of the humerus* are more frequent than all others; as they are usually readily cured, and are generally caused by *mal-adresse*, they are rarely published. But he further says that this accident may occur in the hands of the most expert accoucheur, if the pelvis be contracted. They occur most frequently in the disengagement of the arms after podalic version, when extraction is necessary; and they may also happen in pelvic presentation, but usually, if we do not have to extract the child—that is, if the expulsion can be left solely to nature—the arms will not ascend, but remain applied to the chest. Smellie¹ states that he fractured the humerus in a case in which he turned and delivered by the feet. This is the only instance of injury to the humerus he gives, while he mentions three of fracture of the femur, two occurring in the practice of his assistants and one in his own.

All obstetricians agree that in bringing down an ascended arm it is important that no pressure be made until the internal angle of the elbow is reached, and that three or four fingers should be employed, and not one or two. Pajot regards it as important that the posterior arm should be liberated first. Küstner² describes separation of the epiphysis of the head of the humerus from the diaphysis as one of the injuries of labor which may be overlooked or falsely regarded as a luxation, a fracture of the neck of the scapula, or an injury to nerves. Fractures of the clavicle, separation from its sternal attachment, transverse fracture of the scapula, separation of the epiphysis of the neck of the scapula, injury of the acromion process, and dislocation of the humerus have been observed.

Fracture of the clavicle is most frequently caused by pressing directly with one or two fingers in the endeavor to bring the head through the pelvic inlet after podalic version or in pelvic presentation. McClin-

¹ Sydenham's Society's edition of Smellie's *Midwifery*, vol. iii. pp. 296, 297. This great obstetrician in the first volume remarks: "In laborious or preternatural cases, when considerable force hath been used in delivering the child, the whole body ought to be examined, and if there is any mark or contusion on the head it will disappear if anointed with pomatum and gently rubbed off or chafed with the accoucheur's hand; if any limb is dislocated or broken, it ought to be reduced immediately; luxations, though they seldom happen, are more incident to the shoulder than to any other part, the humerus being easily dislocated and as easily reduced. The bones of the arm and thigh are more subject to fracture than any other of the extremities; the first is easily cured, because the arm can be kept from being moved, but a fracture of the thigh-bone is a much more troublesome case, because over and above the difficulty of keeping the bones in a proper situation, the part is often necessarily moved in cleaning the child."

² *Ueber die Verletzungen der Extremitäten des Kindes.*

took, in one of his annotations to the Sydenham Society's edition of *Smellie*, observes: "Although *Smellie* gives no example of fracture of the child's clavicle during delivery by the pelvic extremities, yet in my experience it is a bone very apt to be broken by the manipulations of the accoucheur, more so even than the humerus; this may perhaps be explained by its greater degree of ossification."

Paralysis of the Arm.—Sinkler recognizes hemiplegia as, in some cases, the consequence of injury at the time of birth, either from the forceps or from the pressure of a prolonged labor. Nadaud gives seven cases of paralysis of the arm attributed to the forceps; the first case of this injury reported is one of *Smellie's*. Jacquemier mentions an instance of paralysis of the deltoid following a long and difficult, but spontaneous, labor; the recovery was complete in fifteen or twenty days. He attributed the disorder to compression of the axillary nerve against the humerus at the point of its attachment to the deep face of the deltoid. Fasbender found in an infant soon after delivery a tumor as large as a pigeon's egg situated above the right clavicle; the hematoma gradually disappeared, but at first there was paralysis caused by nerve-compression. Delore suggests that paralysis may be caused by the rupture of a nerve-trunk near its connection with the spinal cord. He states that this accident is not rare in the newborn or in young infants as a consequence of traumatism; it is followed by incurable paralysis, which is compatible with life if an upper member only is affected. Disengagement of the extended arms in pelvic deliveries, and traction upon the axilla in delayed delivery of the body in vertex presentation—the traction in some cases being with the blunt-hook, in others with the finger—have resulted in paralysis of the arm. The same disability has occurred in a case in which the arm protruded in shoulder presentation and delivery was effected by podalic version.

Luxation of the humerus has in some instances been mistaken for obstetric paralysis. Further, it is important to distinguish between cerebral and traumatic paralysis. Duchenne¹ gives an instance in which there were both cerebral and obstetric paralysis, the latter consequent upon a fracture of the ulna near the elbow.

INJURY TO THE LOWER LIMBS.

Fracture of the femur may be spontaneous or consequent upon artificial delivery.

Meyer has recently² reported 2 cases in which spontaneous fracture of the femur was observed; in 1 a single femur was broken; in the other both femurs. In May, 1847, Dr. Vanderveer³ reported a case

¹ See Nadaud: *op. cit.*

² *Archiv f. Gynäkologie.*

³ *New York Medical Journal.*

of spontaneous fracture in childbirth. But probably more fractures of the femur are caused by the attempt to pull down a lower limb in pelvic presentation, when the presenting part is already partially in the mother's pelvis, before pressing up the presenting part or from the use of the blunt-hook or the fillet. Delore's experiments show that with the untired finger traction to the amount of 15 kilogrammes (37 pounds) may be made upon the groin, and this cannot break the femur. If a force of 55 kilogrammes (137 pounds) is exerted upon the femur, fracture occurs; if the force be perpendicular to the bone, the latter gives way with a pressure of 20 kilogrammes (50 pounds).

Again, the femur has been broken or separation of the epiphyses has been caused by traction upon the leg. A. R. Simpson mentions an instance in which podalic version was performed, the right lower limb brought down, and traction made. Subsequent examination showed that there were three fractures of the femur.¹

Luxations of the femur, consequent upon obstetric operations, are exceedingly rare, according to Ruge. In 300 autopsies upon newborn infants he did not find a single true dislocation of this bone. Küstner, in referring to luxations of the hip, speaks as follows: "Götschen relates a case in which Langenbeek reduced such a luxation after the subject, a girl, was thirteen years old, and mentions in this connection that Stromeier had met with twenty cases. The only possible way in which this injury could occur would be by sudden and violent force drawing down the limb, and then dislocation upon the ilium might result. But the force must be great. I have suspended to the leg of a child from six to ten minutes a weight of from 30–40 kilogrammes (75–100 pounds) without any injury to the joint."

THE TREATMENT OF OBSTETRIC PALSIES AND FRACTURES.—Of course it is of the greatest importance to prevent these accidents, and therefore this prevention will be first considered.

The employment of the obstetric forceps ought to be unequivocally indicated by the interests of the mother or of the child, or still more strongly of both. A suitable instrument should be selected, and then the application made, if possible, to the sides of the child's head. The force used in extraction ought not at first in any case to be great; indeed, in some instances where extraction is very difficult, the wise obstetrician will remove the instrument and wait until nature's forces have moulded the head, for there is little gain in dragging a living child through possibly a torn birth-canal when that child is by such extraction doomed to a remediless palsy or a hopeless idiocy.

It is also to be remembered that not only instrumental, but likewise, manual, delivery may have serious consequences to the child, for, as Lamotte wisely said, "the hand improperly used is more dangerous

¹ *Edinburgh Med. Journ.*, 1880.

than any instrument." If, for example, podalic version be necessary, it is important that the delivery should be left after it to nature, never resorting to extraction unless absolutely necessary.

The proper method of delivering the head in head-last labor is a question of some practical importance in reference to the prevention of injury to the fœtus. In Cieslewicz's collection of cases of fœtal injury in labor there are several in which more or less serious consequences followed the delivery of the head by the Prague method. One of these, reported by Gusserow, showed at the autopsy complete rupture of the vertebral column and most of the soft parts of the neck, so that the head was attached to the trunk only by the vertebral arteries and the skin. Ruge, rejecting both the Prague and the Vienna methods, advises lifting the occiput up and bringing the face down, and carefully employed expression as least liable to injure the fœtus. The application of the forceps to the after-coming head will in some instances deliver an uninjured living child when manual extraction is attended with great difficulty and danger.

If interference is necessary in a pelvic presentation, the question between manual and instrumental means is presented. Dr. Barnes' method of decomposing the wedge and bringing down one of the lower limbs is not attended with the danger of fracture of the thigh which has so often followed the use of the blunt-hook, and in some instances that of the fillet. The application of the forceps to the pelvis is upheld by Miles and Lusk in this country, by Tarnier and a few other obstetricians abroad, but is rejected by most authorities.¹ However, as this matter is fully discussed elsewhere in this volume, it will not be given any more space here.

Facial paralysis of the newborn is usually upon one side only; in rare instances it is bilateral; in most instances the laming has followed a forceps delivery, though in a few instances the labor was unassisted; finally, it may be partial, but generally is complete.

If with the facial paralysis there is palsy of the internal parts of the month—if the velum palati, for example, on the affected side hangs down loosely, occupying a lower position than upon the sound side—the injury to the nerve causing the condition was not from external pressure, and it involves the trunk anterior to its entrance into the petrous portion. In these cases there is no encouragement to use any therapeutic means. But if the paralysis is only of the face, spontaneous recovery usually occurs within six weeks. Its persistence beyond this

¹ For example, in the last edition of Schroeder's *Lehrbuch der Geburtshilfe*, edited by Olshausen and Veit, Bonn, 1888, the following passage is found: "The application of the head-forceps to the hips is to be rejected; the pelvic forceps is falsely constructed in principle, and is entirely worthless."

time indicates the use of electricity : Duchenne advises resort to this means at the end of a month,

Paraplegia in the newborn indicates, according to Nadaud, almost certainly a serious lesion of the cerebro-spinal organs, and the child soon dies. Paralysis of the arm in connection with the same condition of the sterno-cleido-mastoid, and associated with the formation of a tumor in the lower portion of the muscle, whether a hæmatoma or the result of inflammation, disappears with the spontaneous disappearance of the tumor.

Where paralysis results from a depressed cranial bone Dr. Nancrede¹ believes that trephining might be employed.

A fractured clavicle should be treated by fastening the arm, the forearm being flexed, to the chest by means of a roller bandage ; so far as possible, the infant should be kept lying upon the back : the bone will be firmly united in seven or eight days.

Separation of the epiphyseal end of the head of the humerus from the shaft of the bone is an injury to which Küstner has called especial attention ; the injury from which it results would, if applied to the arm of the adult, cause dislocation. The characteristic symptom is that when the infant attempts to move the arm the humerus rotates inward : the accident may easily be mistaken for a dislocation. It is advised by Küstner in the treatment of this injury that the epiphysis, now rotating outward, be brought in contact with the diaphysis, and then the arm is fixed by a bandage to the thorax in a position somewhat outward and backward.

Fractures of the humerus may be successfully treated² "by fixing the whole upper extremity with a moulded splint in a straight position. Fractures of the femur are more difficult to manage. Here sheet vulcanite, which can, by softening in hot water, be accurately moulded to the limb, had better be used, because it will absorb neither urine nor feces. An anterior splint should be made which will extend well up over the abdomen, and a posterior splint to reach from the buttock well below the knee, thus fulfilling the important indication of fixing the joints above and below the fracture. It only requires ten or twelve days for firm union to occur."

A. A. Johnston³ has reported a case of labor in a primipara, the breech presenting, and so firmly wedged in the mother's pelvis that he had to use a blunt-hook. Upon examining the child immediately after delivery, he found a compound fracture of the thigh, the bone having been broken just below the great trochanter, the lower end of the bone projecting through the skin about one inch. The fractured member was put up in cardboard splints, and the infant placed in a rocking-

¹ *Medical and Surgical Reporter.*

³ *Australasian Medical Gazette*, November, 1883.

² Nancrede.

chair instead of in a cradle, the legs of the child being fastened in a perpendicular position to a bar placed across the arms of the chair; the limbs were thus at a right angle to the body, which acted as a counter-extending force. At the end of two weeks the fracture was found firmly united.

Delore¹ states that he met with several fractures of the thigh when he had charge of the Maternité at Liège; he advises in the treatment of this injury the application of a salicylated bandage and placing the member at a right angle to the body.

SUDDEN DEATH DURING OR FOLLOWING LABOR.

Whether one believe, with the Roman emperor, that the death which is most sudden is that most to be desired, or place it, as is done in the rubric familiar to all, at the climax of earthly calamities, such event is always startling and usually most painful to the witnesses. This pain is greatest, the misfortune almost without exception the gravest, if a mother dies in childbirth or soon after. Many causes conspire to make such an event peculiarly sad. The abrupt severing of new ties, the loss of life in giving life, and the sharp contrast between an infant living and a mother perishing just when the former so greatly needs the loving care of the latter, are among these causes.

The obstetrician not infrequently suffers public reproach when such an event occurs in his practice, for people are slow to understand how that which is in the majority of cases a simple physiological process may have a fatal issue. Moreover, in some instances death can be averted if the practitioner, forewarned of its imminence, uses appropriate means; in others the prophecy of such event as possible, probable, or inevitable may protect his reputation; and in still other cases, if prophecy should fail—the event, casting no shadow before it, coming unexpectedly to him as to others—his ability to explain its cause is very important. It is therefore alike the duty and the interest of the obstetric practitioner to study carefully the causes of sudden death in childbirth and in the first part of childbed.

Constant supply of oxygen to the organism and the regular distribution of blood suitable for nutrition are the two essentials² for the continuing of life—in other words, the lungs and the heart must perform their respective functions, and thus the tripod of Bichat is replaced by a biped, for the brainless fowl lives, though it instantly perishes if deprived of heart or lungs. In most cases of sudden death the heart, the *ultimum moriens* of Galen, first stops—or, in other words, death is caused by syncope, not by asphyxia. If death begins at the lungs, the fatal event is usually slow in progress; nevertheless, it may then in

¹ *Op. cit.*

² Strauss.

some instances be sudden, as from pulmonary embolism, just as, on the other hand, cardiac death does not always occur even rapidly. In still other cases, lungs and heart may both fail, the failure of neither being the exclusive cause of death.

Without designing or desiring to classify the causes of sudden death as cardiac or pulmonary or cardio-pulmonary, when observed by the obstetrician, I shall present the chief immediate causes of sudden death during or after labor.

1. DEATH FROM MENTAL EMOTION.—The fact that syncope may be caused by a strong mental impression, as fear, anger, joy, or sorrow, is familiar to the profession as well as to the public. A reasonable supposition is that in such cases the impression upon the brain is first reflected to the bulb, then probably through the pneumogastric nerves the bulb itself arrests the action of the heart, and hence the sudden paleness, the cerebral anæmia, and the syncope.¹ Wundt, adopting Kant's classification of emotions into sthenic and asthenic,² says that the former kill by apoplexy, and the latter by cardiac paralysis, or rather by the interruption of cardiac function which energetic and persistent excitement of the inhibitory nerves of the heart causes.

Several examples of sudden death from great joy are recorded by Tuke in his well-known work,³ and Montaigne has narrated⁴ one of the most striking instances in which such death was caused by profound sorrow. The familiar lines uttered by Malcolm in *Macbeth* show that the great master of tragic poetry recognized the truth that deep grief might cause fatal syncope:

"the grief that does not speak
Whispers the o'erfraught heart, and bids it break."⁵

¹ Strauss: *Nouveau Dictionnaire de Médecine et de Chirurgie pratiques*, t. 34.

² *Elements of Physiological Psychology*.

³ *Illustrations of the Influence of the Mind in Health and Disease*.

⁴ The story, as told by Montaigne in his *Essays*, is the following: "In the war that Ferdinand made upon the widow of King John of Hungary about Buda, a man-at-arms was particularly taken notice of by every one for his singular gallant behavior in a certain encounter, and, unknown, highly commended and lamented, being left dead upon the place, but by none so much as by Ratsciae, a German lord, who was infinitely enamored of so rare a valor. The body being brought off, and the count, with the common curiosity, coming to view it, the armor was no sooner taken off but he immediately knew him to be his own son—a thing that added a second blow to the compassion of all the beholders; only he, without uttering a word or turning away his eyes from the woeful object, stood fixedly contemplating the body of his son till the vehemency of sorrow, having overcome his vital spirits, made him sink down stone-dead to the ground."

⁵ The same great poet has, in his *Julius Caesar*, represented Cæsar's death as not the consequence of injury inflicted upon his body, but of profound emotion:

"For when the noble Cæsar saw him stab,
Ingratitude, more strong than traitors' arms,
Quite vanquished him: then burst his mighty heart."

The greater nervous susceptibility of woman than of man, and its notable increase during pregnancy, would explain the special liability she would then have to be injuriously affected by a profound emotion, whether of pain or of pleasure. It has sometimes happened¹ that a premature labor has been thus caused, and in rare cases this labor has been soon followed by death. But such untoward results are probably, as a rule, only consequent upon powerfully depressing emotions or those which by Kant were called asthenic, such as great sorrow, grief, or fear suddenly occurring. In case death follows this premature labor, it may be explained as caused by exhaustion, or the immediate cause may be hemorrhage from uterine atony, this atony itself being the result of the prostrate condition of the system.

Chevallier has collected and narrated cases of sudden death occurring to puerpere which he attributed to idiopathic asphyxia. But, as remarked by McClintock,² "some very competent authorities look upon the mortal affection described by M. Chevallier as merely a form of syncope." Undoubtedly the latter term is the correct one. It is remarkable that several of the cases adduced were those in which death followed a strong emotion—in other words, they were instances of fatal emotive syncope. One of these, for example, taken from Morgagni, was that of a multipara who after an easy labor was delivered of a girl, her husband and she both being desirous of a boy; the sex of the child was imprudently told her: she was affected with such deep sorrow that her pulse became weak and her skin cold, and in a few hours she died; the autopsy presented no satisfactory cause of the fatal result.

McClintock quotes from Travers the following case: "A young lady, happily married, impressed probably by some unexpectedly fatal occurrence in the circle of her friends, entertained from the commencement of her pregnancy a morbid fear of death in childbirth, which, although

Both these quotations attribute the failure of the heart to its rupture; and this accident is quite possible from emotional causes. In Dr. Stroud's well-known work, *Treatise on the Physical Cause of the Death of Christ*, London, 1847, the author maintains the view that this cause was agony of mind producing rupture of the heart. In a recent volume by Sir Risdon Bennett, M. D., etc., entitled *The Diseases of the Bible*, London, 1887, this eminent physician discusses the subject and fully accepts Dr. Stroud's conclusion.

¹ Probably one of the earliest, if not the earliest, of all instances of premature labor caused by emotional disturbance, the labor being followed by immediate death, is that recorded in sacred history concerning the daughter-in-law of the high priest Eli. The great novelist and the great poet, whose pictures are true representations of reality, furnish similar examples. Thus, by way of illustration, in Scott's *Guy Mannering*, Mrs. Bertram, suddenly learning the loss of her little boy, and thus subjected to violent sorrow, has a premature labor, and immediately dies. In Shakespeare's *Pericles, Prince of Tyre*, Thaisa, the wife of Pericles, is far advanced in pregnancy when in the passage from Pentapolis to Tyre a storm arises, threatening shipwreck, and the fear of this brings on labor, and after its termination death rapidly ensues.

² *Dublin Medical Press*, 1852.

unwarranted by any indication, became, from its continuance and increasing strength, a source of anxiety to one of her immediate and confidential relatives. She was attended by a skilful and experienced accoucheur, who was also her relation. He assured me that the labor was in all respects easy and safe, and that not a single unfavorable circumstance attended it. The child was stillborn and imperfect. The mother died suddenly in six hours after delivery. Every region of the body was examined with care by an eminent anatomist, and presented the appearance of health."

Mordret has taken¹ from La Motte's *Observations* the case of a laborer's wife who had to accept, though greatly dreading, the services of this celebrated accoucheur in a difficult parturition. La Motte found an arm hanging from the vulva, and he readily performed version and delivered her of a dead child; the placenta too was delivered, but the woman was trembling, though she had no chill, and half an hour after the labor died without previous hemorrhage, pain, or any other appreciable accident. Mordret believes that the death was owing solely to fear.

2. DEATH MAY RESULT FROM SEVERE SUFFERING.—A temporary syncope from violent pain has been often witnessed not only in females but in males, not only in adults but in children. It is not wonderful that the sufferings of childbirth, if very severe or protracted, should cause sudden death. Mordret remarks that an acute and continued pain is the most active enervant, and many times women die in labor or soon after, and the fatal result cannot be attributed to anything else than the excessive pains of a long and difficult delivery. The elder Ramsbotham and Travers had previously expressed a similar opinion.

Winckel² refers to strong mental emotion, especially severe suffering, as a cause of sudden death, and states that Baart de la Faïlle has collected 13 cases of post-partum collapse in which neither embolism nor the entrance of air was probable, but in which, however, the entire complexus of symptoms had very great similarity to cardiac paralysis.

Dr. Lusk³ lost a primipara two hours after delivery with forceps, and he attributed the death to "nerve-exhaustion and shock." Dr. Fayette Dunlap,⁴ in the case of a patient dying a few hours after the termination of her labor, regarded exhaustion as the cause of the unhappy event.

3. DEATH MAY BE CAUSED BY DISEASE OF THE HEART.—Cases of sudden death from fatty degeneration of the heart have been reported by Purefoy⁵ and Jenks⁶ and others. That of Purefoy is as follows:

¹ *De la Mort subite dans l'État puerpéral*, Paris, 1858.

² *Lehrbuch der Geburtshülfe*.

³ *Journal of the American Medical Association*, 1884.

⁴ *Ibid*, 1887.

⁵ *Dublin Journal of the Medical Sciences*, 1855.

⁶ *Transactions of the American Medical Association*, vol. xxix., address in obstetrics, "The Causes of Sudden Death of Puerperal Women." This address is a valuable

The subject was thirty-six years old and a primigravida. A short time before labor began she complained of difficult breathing and præcordial impression, and these symptoms increased in severity with the progress of parturition; she died during the first stage. At the autopsy the uterus and its contents were found in every respect normal; the os was dilated to the size of a crown-piece; the presentation normal. The abdominal viscera were healthy; the lungs were in a state of recent congestion; the pericardium contained about two ounces of reddish-colored serum, whilst the heart was much enlarged, being in its greatest length about nine inches and from four to five inches in breadth at its base. "This organ had undergone fatty degeneration to a considerable extent, with the usual softening of its muscular fibre, and thus, being unfitted for its office, had failed to fulfil its all-important function in the hour of need."

Dr. Alexander R. Simpson¹ has narrated the case of a multipara less than forty years of age who died two hours after spontaneous delivery, and the autopsy showed "a heart pale and soft and freely overlaid with fat:" he attributed the death "to the exhaustion attendant on the process of delivery, and the consequent failure in the action of a feeble, fatty heart."

Franz² has reported the case of a multipara who died just after the delivery of the placenta, complaining of cardiac distress; the autopsy showed a fatty and dilated heart. Danyan in 1852 also reported a sudden death from the same cause twenty days after labor.

Rupture of the heart has been in some instances the cause of sudden death of puerperæ. In a case reported³ by Spiegelberg death occurred in five minutes three days after labor, and the autopsy showed rupture of the left ventricle as a consequence of acute myocarditis. In M'Nicol's case⁴ a woman, two weeks after delivery followed by normal convalescence, while getting out of bed, exclaimed, "Oh, nurse, something has given way! I'm fainting." She died in twenty minutes, and upon post-mortem examination there was found an opening half an inch long in the walls of the right ventricle, which were very thin—fatty degeneration of the heart existed, although not to any great extent.

In connection with the first case reported the views of Coste⁵ may be stated. According to him, sudden death after delivery is due either to a hemorrhage or to a thrombosis of the pulmonary artery or to a myocarditis. As hemorrhage causes death more or less rapidly, and as, on

contribution to the subject. Another excellent article upon the subject, from the pen of Dr. S. L. Jepson of Wheeling, W. Va., will be found in the *American Journal of Obstetrics*, August, 1872.

¹ *Contributions to Obstetrics and Gynecology*.

² *Memorabilien*, 1874.

³ *Monat. f. Geburt.*, xxviii.

⁴ *Lancet*, March 20, 1852.

⁵ *De la Myocardite puerpérale comme cause la plus fréquente de Morts subites apres l'Accouchement*, Paris, 1876.

the other hand, thrombosis of the pulmonary artery appears to be caused by a degeneration of the myocardium, we may conclude that sudden death after labor is almost always the result of myocarditis.

4. DEATH MAY BE CAUSED BY RUPTURE OF THE AORTA OR OF THE SPLEEN.—Henricius has reported¹ the case of a multipara thirty-eight years of age who, in the second stage of labor, the uterine contractions being good and her general condition excellent, had suddenly-occurring spasmodic contractions of the lower jaw and of the members for a few seconds, and then died. The forceps was used five minutes after the death of the mother, and a child delivered which was with difficulty resuscitated. The autopsy showed rupture of the aorta, which was attributed to increase of blood-tension caused by the violent uterine and abdominal contractions on the one hand, and on the other simultaneous reaction of the heart against this obstacle.

Spontaneous rupture of the spleen is a rare accident, but it has been observed in pregnancy and during labor or after: it is unnecessary to state that such rupture is impossible without some change in the structure of the organ, and that it is rapidly mortal.

Whitney² has narrated the case of a woman eight months pregnant in whom the accident occurred immediately after taking a meal.

Sir James Simpson³ has reported three cases of ruptured spleen. The first was that of a woman to whom the accident occurred in the sixth or seventh month of pregnancy; the second patient a week after delivery made some unusual muscular exertion, complained of severe abdominal pain and exhaustion, and died in a brief time; the third had been delivered with forceps, and within two hours after was dead: an autopsy in each case proved the nature of the accident.

Dr. Hubbard's⁴ patient, a multipara who had been living in a malarial region and had great enlargement of the spleen, died six or seven hours after the spontaneous termination of her labor: the spleen weighed four pounds.

Carl Schwing⁵ has reported a case of death from rupture of the spleen during labor: abdominal section was at once made, but the child was dead.

5. DEATH MAY BE CAUSED BY SOME ONE OF THE ACCIDENTS OR COMPLICATIONS OF LABOR.—Thus a patient may perish in eclampsia from acute asphyxia, though usually when asphyxia is the cause of death in this disease it is gradual, or it may be rapid, but rarely sudden. Inversion or rupture of the uterus may be immediately fatal in either case from hemorrhage or from shock, or probably in most cases from the two combined. Hemorrhage during labor, both when the

¹ *Centralblatt für Gynäkologie*, 1884.

² *Boston Medical and Surgical Journal*, 1868.

⁴ *Boston Medical and Surgical Journal*, 1870.

³ *Edinburgh Medical Journal*, 1866.

⁵ *Centralblatt für Gynäkologie*, 1880.

placenta occupies its normal site and also when it is previous, and hemorrhage after labor, may be the cause of sudden death.

6. PULMONARY THROMBOSIS has in several instances caused sudden death, but usually this accident does not occur in the earlier period of childbed, and it is generally preceded by phlegmasia alba dolens. The unhappy victim may have taken the erect or sitting position after having been recumbent for days or weeks, or made other slight exertion, and death come suddenly almost as if from a thunderbolt.

But death may be caused by embolism just after labor as a consequence of artificial thrombosis in a uterine vessel. Herman and Brown have reported the following case: An intra-uterine injection of a solution of perchloride of iron was used for post-partum hemorrhage, and the woman died, the death being attributed to an embolus from a thrombus in the uterine vein.¹

7. DEATH MAY BE CAUSED BY THE ENTRANCE OF AIR INTO THE UTERINE VEINS.—Churchill, who almost alone among writers of works upon obstetrics very fully considers the subject of sudden death in the puerperal woman, states² that the absorption of air by the uterine veins was suggested by the younger Legallois in 1829, and by Ollivier in 1833, as being possibly the cause—at least of some—of the sudden deaths after delivery. Hervieux, after a full consideration of the subject and the presentation of cases of death apparently from air-embolism,³ gives the following conclusions: 1. The incontestable reality of cases of sudden death from the presence of gas in the circulatory system of lying-in women. 2. The impossibility of attributing the presence of these gases to cadaveric cause—that is, to beginning putrefaction; the proved chemical identity of these gases with the gas of the blood, and the probability of their spontaneous development during life; the necessity of attentively watching lying-in women who have had severe uterine hemorrhage, and, although the introduction of air by the uterine veins has not been proved, the duty of the practitioner not to resort to intra-uterine injections except with the greatest reserve and rigorously conforming to all the precepts of art.

Hervieux's scepticism as to the entrance of air into the uterine veins is not now at least the voice of the profession, for numerous cases have demonstrated the fact. Thus in the patient⁴ of Olshausen there was employed while she was in labor a uterine doneche to hasten effacement of the cervix; she complained of pain, raised herself up in bed, gave some deep inspirations, and died in a minute. At the autopsy, made eight hours after death, bubbles of air were found in the cardiac ves-

¹ *Obstetrical Journal of Great Britain and Ireland*, January, 1880.

² *Theory and Practice of Midwifery*, 6th ed.

³ *Maladies puerpérales*.

⁴ For these cases see Braun on "Sudden Death from the Entrance of Air into the Uterine Veins," *Wien. med. Woch.*, 1883.

sels, in the uterine veins, and in the inferior vena cava. In Litzmann's case four uterine douches were given with Mayer's pump to induce premature labor; suddenly the woman became livid, and died in a few seconds. The post-mortem, made sixteen hours after death, showed bubbles of air in the uterine veins and in the ovarian and renal plexuses. Gunz has reported the case of a girl twenty years of age who was found dead in her room, having between her limbs an irrigator, the canula being in the vagina. She was found to be three months and a half pregnant, and the death was shown to have resulted from the entrance of air into the veins, the canula having penetrated the cervical canal. Spontaneous entrance of air is illustrated by the following case: A secundipara, twenty-five years of age, was after an easy labor delivered of her child while lying upon her side; she was then turned upon her back, gentle massage used, and the placenta was expelled. The face suddenly became livid, the respiration labored, the pulse weak; after vomiting a little mucus and after slight convulsive movements she became collapsed, and died. At the autopsy the uterus was found as large as the head of a child, and its walls relaxed. In compressing the posterior wall and the fundus of the uterus at the place where the placenta had been attached fine crepitation was heard; when the organ was thrown into water a great number of small bubbles of air escaped. The parts of the uterus near the cervix did not appear to contain air, nor did the veins of the broad ligament, the ovarian veins, or the vena cava.

Another instance is the following: Cordwint has given¹ the history of a primipara, twenty-eight years old, who was delivered while standing of a living male child, which fell to the floor, dragging the placenta and membranes with it. A "gurgling" was heard by the attendants, and the woman died almost immediately. At the post-mortem air was found in the uterine wall at the fundus, in the coronary vein, and in the right heart.

Winckel,² in referring to the entrance of air into the uterine veins as a cause of sudden death, remarks that in an examination during labor, in the removal of the placenta from the vagina, in the introduction of the hand into the uterus for the purpose of removing the placenta, the introduction of air is almost inevitable, and that sometimes the contained air escapes with a quite audible sound. He also refers to the fact that if the os uteri be closed and decomposition of retained material occur in the cavity, gas may enter the circulation.

Madden,³ in a paper upon "Sudden Death soon after Parturition," gives among other cases that of a woman who had been delivered the previous day with forceps, and who sat up to urinate, and then took

¹ *St. George's Hospital Reports*, London, 1873.

³ *American Journal of Obstetrics*, August, 1871.

² *Op. cit.*

some warm whey ; a few minutes afterward, while talking to the nurse, she changed countenance, hicoughed once or twice, and expired almost immediately : the death was attributed to the entrance of air into the uterine sinuses.

Krukenberg¹ has suggested it probable that air may enter in case of Cæsarean operation when the placenta lies directly in the line of incision.

Lauff's has collected² 43 cases of air entering the uterine veins. In 17 the accident was caused by injections into the birth-canal, 18 were spontaneous, and 8 resulted from the formation of gas in the uterus : 39 of the 43 were fatal, and the presence of air was proved by the autopsy in 31.

8. SUDDEN DEATH MAY BE CAUSED BY AN AFFECTION OF THE RESPIRATORY ORGANS.—Mordret quotes from Devilliers a case in which death occurred during labor five or six minutes after sudden aggravation of the symptoms of pulmonary congestion. At the autopsy no other lesion than congestion of both lungs was found. La Motte has narrated a case in which death occurred suddenly after labor from a severe attack of asthma, and Depaul one in which the cause of the fatal result was pulmonary emphysema. Instances of puerperæ dying from pneumonia or from pleuro-pneumonia have been recorded, but in these cases the death was rapid rather than sudden. Pulmonary apoplexy, however, may cause sudden death.

Warren³ has published a case of death a few hours after labor resulting from pulmonary œdema.

Dr. S. Salisbury⁴ had a patient die two hours after her third labor from pleural effusion, the left pleural cavity being filled, compressing the lung. Symptoms of pleuritis had first appeared about a week before, but were not serious enough to interfere with her being up and attending to household affairs.

There have been thus presented the chief causes of sudden death during or after labor. It is necessary to add a brief statement of cases of sudden death from exceptional causes or from those which were conjectured or entirely unknown.

Merriman, under the head of "Dystocia Syncopalis," has given the following report of a case of sudden death in which probably the autopsy would have failed to show any organic lesion : "An accoucheur was once attending a woman in labor with her first child. Soon after it commenced, and during his absence, she fainted without any

¹ Schroeder.

² *Ueber Eintritt von Luft in die Venen der Gebärmutter bei und nach der Geburt*, Bonn, 1885.

³ *American Journal of Obstetrics*, 1884.

⁴ *Boston Medical and Surgical Journal*, 1870.

obvious cause. On his return the circumstance was mentioned; but, as by this time she appeared perfectly recovered, no further notice was taken of it, and she was safely delivered without any other unusual symptom. On the third day after delivery she took a dose of aperient medicine, and, while in the act of relieving herself, fell back and immediately expired. Probably no care would have prevented this unfortunate event. It was perhaps inexpedient to give the patient a purgative under such circumstances—a clyster would have been a more appropriate remedy, and at all events an erect posture should have been strictly forbidden.”

Charles has recently reported¹ a case in which the death was attributed by him to uræmic poisoning.

Spencer has reported² the case of an anæmic primigravida who had eclampsia and premature labor, giving birth to twins; sudden death occurred, and the autopsy showed a large quantity of blood in the abdomen, no rupture of the uterus, but a gastric ulcer, with rupture of an artery.

One of Madden’s cases³ is that of a woman who died soon after delivery, and the autopsy showed the cause of death to be hemorrhage from rupture of a varicose ovarian vein.

The late Dr. Charles D. Meigs in 1849 directed⁴ professional attention to heart-clot as a cause of sudden death in the puerpera, claiming to have discovered that this accident most commonly depends “on the sudden coagulation of the blood that occupies for the time the right auricle of the heart, and in some of the cases even that which is in the ventricle and the pulmonary artery.” His theory was that in consequence of hemorrhage the coagulability of the blood being increased, sudden exertion caused fainting, and in consequence thereof “the blood is likely to become concrete if it but come to a stop in the auricle.”

Playfair in 1871 reported⁵ a case of sudden death after labor which he attributed to a thrombus in the right side of the heart and pulmonary arteries.

Haughton has reported⁶ the case of a multipara who ten days after normal labor left the bed to evacuate the bowels; sudden syncope occurred, and in forty minutes she died. There was no post-mortem, and heart-clot was suggested as the probable cause of death.

Dr. Fordyce Barker states⁷ that “observations have demonstrated that clots may form both in the pulmonary artery and in the right cavity of the heart as a primary lesion.”

Pathologists have not settled the question as to the formation of a

¹ *Journal d'Accouchements*.

² *Medical Press and Circular*, 1873.

³ *Op. cit.*

⁴ *Philadelphia Medical Examiner*.

⁵ *London Obstetrical Society's Transactions*, vol. xiii.

⁶ *Cincinnati Lancet*, 1855.

⁷ *Puerperal Diseases*.

primary thrombus in the right side of the heart and in the pulmonary arteries, some denying its occurrence.

Therefore the spontaneous formation of a cardiac thrombus may be regarded as doubtful—reference is not had to such coagulation as may occur in dying—and too often death from heart-clot is a veil for our ignorance. So, too, cardiac paralysis or heart-failure merely reveals a symptom, a consequence, or an effect, the cause being unknown. While usually the cause of sudden death in labor or in the puerperal state may be ascertained, in rare instances this is impossible. Thus Dr. Jackson¹ narrates the case of a woman who ten days after her delivery, while walking across the room, fell down dead, but nothing was found at the autopsy to explain the death.

The preventive TREATMENT of this accident needs only brief consideration. Some of the cases here presented carry their own moral, plain to him who reads; in other instances no human science and skill could have averted the fatal issue—death was inevitable.

It is important that the obstetrician should know not merely the physical, but also the mental, condition of his patient; knowing the latter, he may, by prudent speech and thoughtful suggestion and wise tact, defend her from perils to the body that come through the avenue of the mind. Coleridge said that he was the most successful physician in the treatment of nervous diseases who was most successful in inspiring hope. No matter how learned an obstetrician may be in a knowledge of the phenomena of labor, how great his experience, and how wise and skilful in the employment of artificial aids to labor, he makes his qualifications still greater if he knows how in all cases to inspire hope, dissipating gloomy forebodings, and sedulously guarding patients against all injurious mental influences, whether ignorant suggestions of meddling friends or true statements made inappropriately in manner or time. If ever a woman needs to have both sympathies and antipathies respected, it is when enduring, or when she has just endured, the perils of childbirth.

So far as the actual management of labor is concerned, certain conditions liable to cause death demand artificial delivery. If the woman has been upon her side during the expulsion of the child, and then turns upon her back, this change should not be made without compression of the uterus through the abdominal wall during it. Intra-uterine injections must never be used unless the indication is unequivocal, and then preferably by an irrigator rather than by the ordinary syringe; so, too, injections of a solution of one of the iron salts are to be regarded as a last resort—they are rarely if ever required. Aspiration by puncturing the cardiac ventricle in air-embolism, recommended by some, has never yet been tried in the human subject, and would prob-

¹ *Boston Medical and Surgical Journal*, April 7, 1870.

ably only prove a desperate experiment. Abrupt changes of position, and especially sitting up in the early days of the puerperium, even for evacuation of bladder or bowel, are to be avoided: such precaution is especially required if the woman was anæmic before her labor or has had post-partum hemorrhage or hemorrhage during the labor. Mental and physical rest is nature's instinct and nature's law for the puerpera.

DEATH OF THE MOTHER IN LABOR OR IN THE LATTER PART OF PREGNANCY.—CONDUCT OF THE OBSTETRICIAN.

Cases of spontaneous expulsion of the child after the death of the mother, not only when in labor, but also in pregnancy, have been reported. Aveling¹ has collected 44 of these. Some in this collection must be regarded as extremely doubtful, as, for example, the following: "Rudolph Camerarius tells us of a Spanish inquisitor who caused a pregnant woman to be hanged in 1551. Four hours after the death of the unhappy mother, while still hanging on the gibbet, two living children fell from her womb."

So too, the statement made in Aveling's paper, "After the death of its mother a child may continue to live in the uterus for many hours," is, in the light of the results obtained by artificial post-mortem deliveries, most improbable.

Spontaneous post-mortem delivery is usually caused by accumulation of gases from decomposition in the abdominal cavity, causing such pressure upon the uterus that its contents are expelled. Some, however, have claimed that at least in a few instances the expulsion of the fœtus resulted from the contractile power of the uterus still existing for a time after death, while the resistance of the birth-canal is lessened. Of course in an age when the old doctrine of a child escaping from the uterus by its own power was still held, the birth of a living child after the mother's death was plain.

Expulsion of the fœtus after the death of the mother is, of course, a very rare occurrence, and still rarer are the instances in which the expulsion occurred soon enough after that death for the child to be living. Therefore it is a universally-received law of the profession that artificial post-mortem delivery should be employed in all cases in which the child is living and capable of living after its extraction. The writer of an essay upon this subject has wisely taken as its motto, "*Quem servare potuisses, non servasti, occidisti.*" Six hundred years before the birth of Christ, Numa Pompilius enacted a law directing that the bodies of women dying in pregnancy should be immediately opened, his object being thus to save citizens for the state. Very probably post-mortem artificial delivery was much older, for in

¹ *London Obstetrical Society's Transactions*, vol. xiv.

the mythology of Greece the stories of the birth of Bacchus and of Æsculapius, each of these being removed from a dead mother by that which subsequently became known as the Cæsarean operation, point to an earlier date.

The law of Numa Pompilius¹ was observed in Venice in 1608 and in 1722; and in 1749 the king of Sicily punished medical attendants with death who omitted the operation upon pregnant women soon after they expired.

Hubert observes that the Church merely reproduced the injunction of the Roman law in the following decree of its ritual: "*Si mater prægnans mortua sit, fractus quam primum caute extrahatur.*"

Of course the child must be living and capable of continuing to live after its extraction to justify this operation. A fœtus born at four months may live for an hour or more: Cazeaux has given an instance in which life continued for four hours. The fœtus born at five months lives still longer, while one born at six months may live from one to fifteen days. Considering that we cannot know with absolute certainty the time in pregnancy when the mother's death occurs—the gestation may be a few days or even a few weeks longer than supposed, and thus the child be undoubtedly viable—we do well to adopt the rule given by Duer² in his elaborate paper: "Artificial removal of the child should be done in otherwise favorable cases which have attained to the neighborhood of the sixth month of pregnancy," for, though this is extreme, we will thereby be prevented from allowing a viable fœtus to perish in the abdomen of a dead mother on the ground of the gestation not having continued long enough. Moreover, we should remember, as pointed out by Tarnier, that the usually accepted period of viability, seven months, ought to be shortened, since by the employment of the couveuse and of gavage many a child born under seven months has been saved.³

Obstetric writers in referring to post-mortem Cæsarean operation are very positive in urging its early performance. Thus, Spiegelberg has stated that, generally speaking, not more than ten minutes must elapse between the death of the mother and the extraction of the fœtus, although there are instances on record in which living children were delivered at a greater interval and recovered. Schroeder said that it was only exceptionally a child extracted more than ten minutes after the death of the mother lived; and Zweifel holds that a post-mortem Cæsarean operation can only be successful when performed immediately or only a few minutes after the death of the mother. In Duer's valuable table, including 55 cases, the time that elapsed between the death of the mother and the removal of a living child was in 40 as follows: between 1 and 5 minutes, including "immediately" and "in a few

¹ Aveling.

² *Amer. Journ. of Obstetrics*, vol. xii.

³ *Cours d'Accouchements*.

minutes," there were 21 cases; between 5 and 10 minutes, none; between 10 and 15 minutes, 13 cases; between 15 and 23 minutes, 2 cases; after 1 hour, 2 cases; and after 2 hours, 2 cases. In addition to the last 2 cases given in this collection, it may be stated that Hubert has recorded a third case in which a living child was extracted from a woman who had been dead two hours.

In those instances in which a living child has been removed at a longer period after the death of the mother than the child usually survives, and especially when that period lasts as long as an hour, there may possibly be some doubt as to the precise time of the mother's death being accurately known, for it may not have occurred as soon as it was believed to, and therefore the survival of the child was not so extraordinarily prolonged.

In determining the question as to whether the child is probably living we may be assisted by considering the cause of the mother's death. Thus if her death be from uterine hemorrhage or rupture, or if it be from eclampsia or from rupture of the heart or of a large blood-vessel or of the spleen, most probably the child is dead. So too, if the mother should die gradually, the child in most cases dies when she dies, or even before.

Hearing the foetal heart-sounds is conclusive as to the life of the child; but the opposite conclusion must not be drawn from our failure to hear them, for in rare instances these have been unheard during the entire pregnancy, and then a living child has been born. In those cases, however, in which the foetal heart-sounds, after having been heard normal in force and frequency, have become irregular, weak, either with their frequency greatly increased or lessened, and finally ceased, the obstetrician has witnessed the dying agony of the foetus and extraction is not indicated.

In regard to the method of delivery, if the labor be so well advanced that extraction with the forceps or by podalic version can be promptly done, one or the other should be selected. It has happened in the use of the forceps in these cases that an apparent has been mistaken for a real death, just as a similar error has been committed in the performance of the Cæsarean operation, though of course the error in the latter is a more grievous one.

But in case the labor is in progress when the mother dies, and the child cannot be at once delivered through the natural passage, or if death occur in pregnancy, the only resort is the Cæsarean operation. In its performance the practitioner will be guided by the same rules and use the same precautions as if he were operating upon the living subject.

Not only is post-mortem Cæsarean operation a recognized means of delivery, but also its performance ante-mortem has been advised by

Löwenhardt under certain circumstances; that is, during the agony when a delay until the mother is dead would probably result in the death of the child. This proposition has received the indorsement of Spiegelberg: he has, however, added this counsel: "A conclusion should never be arrived at except after consultation with another accoucheur, nor should the step decided on be carried out except with the consent of the nearest relatives of the pregnant woman." While on theoretical grounds this practice may be justified, it seems extremely doubtful if most would not revolt against it as inhuman. We are required to perform a grave operation upon a dying woman, which adds to her suffering and probably shortens her existence. Better than the consent of friends would be her consent, obtained previously when she is informed that the disease from which she is suffering will probably be fatal before her pregnancy ends, and the hope of saving her child by the proposed operation made known to her.

DISEASES OF THE MOTHER WITH REFERENCE TO LABOR.

In general it may be asserted, as was stated by Desormeaux and Dubois more than half a century ago, it is rare that a woman is so enfeebled by disease that spontaneous expulsion of the fœtus, when all else is favorable, is impossible; the suffering consequent upon uterine contraction evokes from the economy a high degree of energy, which often, however, may be followed by collapse. The woman suffering with pulmonary tuberculosis frequently has an easy labor, partly from the diminished resistance of soft parts, and partly too from the fact that the child is, from imperfect nourishment, usually under size.

As a general rule, in serious disease of the respiratory organs the child should be delivered artificially, generally by the forceps. So too in case of meningitis observation has shown that the uterine contractions increase the patient's suffering, and even may cause convulsions, no renal disease being present; and therefore in such a case prompt artificial delivery is indicated.

Cardiac lesions may present great danger in labor. Authorities generally agree that the most frequent form of disease of the heart observed in pregnant women is mitral insufficiency,¹ but mitral stenosis is more grave, according to both Macdonald² and Porak. Marty's³ statistics include 15 of aortic insufficiency, 5 of aortic narrowing, 65 of mitral insufficiency, 3 of mitral and aortic insufficiency, 40 of mitral

¹ Zweifel, *op. cit.*, refers to a woman who in the fourth month of pregnancy, when about lying down upon her bed, suddenly fell to the floor, and very soon expired: the autopsy showed absolutely no change, and no other cause of death than mitral insufficiency.

² *Chronic Disease of the Heart in Reference to Pregnancy and Parturition.*

³ *Des Accidents Gravidocardiaques*, Paris, Thesis, 1876.

narrowing, 51 of mitral narrowing and insufficiency, and 25 of mitral and aortic narrowing and insufficiency. In 13 cases the mothers died, and in 11 the children were stillborn, while several of the children died soon after delivery.

Obstetricians agree that cardiac disease does not contraindicate the employment of chloroform in labor, and indeed some assert that the presence of the disease invites the use of an anæsthetic. Very great prostration of the woman, either during or after labor, is best counteracted by frequent hypodermic injections of sulphuric ether. Macdonald¹ taught that all legitimate means ought to be used to lessen the effects of the down-bearing efforts, and therefore the judicious and timely application of the forceps, or, in suitable cases, the performance of version if the second stage of labor happens to be in any way prolonged. In case the quantity of amnial liquor be great, the early rupture of the membranes is indicated, so that the cardiac space may be less encroached upon by the uterus.

Winckel² states that in 8000 deliveries during the last seven years there were 22 cases of cardiac disease, 1 only of the women dying; but 14 of the 22 were primiparæ, in whom any serious complication from cardiac disease in pregnancy, in labor, or during the lying-in is altogether exceptional.

The subject of mitral stenosis in relation to the third stage of labor is the subject of a valuable study by Dr. Berry Hart.³ He observes in the course of his paper that mitral stenosis is in itself a serious cardiac disease apart from any pregnancy, inasmuch as the weak left auricle soon fails in its increased duty, the lungs become engorged, and the right side of the heart dilated. He holds that if free hemorrhage does not occur during the third stage of labor, there is returned to the right side of the heart the extra amount of blood before accommodated in the uterine and placental sinuses; hence the right heart is distended and pulmonary engorgement is present. He advises the tincture of strophanthus if circulatory disturbances are present in pregnancy: this medicine is to be continued during the labor, delivery is to be accomplished as soon as possible, and during it chloroform is used. In the management of the third stage of labor no ergot is to be used, and the occurrence of hemorrhage is favorable, while its absence is often followed by serious symptoms. Should the circulation become embarrassed, as shown by irregular action of the heart or by dyspnoea, the strophanthus is to be pushed and dry cups applied over the heart.

More recently Ballantyne⁴ has published an interesting paper upon "Mitral Stenosis in Labor and the Puerperium."

¹ *Op. cit.*

³ *Edinburgh Medical Journal*, February, 1888.

² *Op. cit.*

⁴ *Ibid.*, March, 1888.

THE FORCEPS.—EMBRYOTOMY.

By EDWARD P. DAVIS, A. M., M. D.,

PHILADELPHIA.

THE FORCEPS.

THE obstetric forceps may be simply defined as an instrument composed of two blades, designed for the extraction of a living child.

Each blade consists of a cephalic portion adapted to the contour of the foetal head, and an external portion terminating in a handle; about midway between the extremities is the appliance used for maintaining the blades in apposition, commonly called the lock. In the early forceps the cephalic portion of the blade was solid; in later forceps an ovoid aperture, the fenestra, has been constructed, whose longer axis is parallel with that of the blade which contains it.

HISTORICAL.—The word “forceps” is derived from the Latin *formus*, warm, and *capere*, to seize. Virgil¹ describes the Cyclops as handling iron with the forceps while working at their forges at Mount Ætna, and Ovid also mentions its use as a tool.

The idea which first suggested its construction was the substitution of an instrument for the human hand; and this idea is strikingly apparent in several of the early models of obstetric forceps. The earliest instruments to which obstetricians had recourse when the hand failed were those used in the interests of the mother only, and were hooks. Hippocrates possessed an instrument for removing the foetus from the mother; Soranus, among his seven instruments for craniotomy, possessed a hook; Celsus had a similar instrument; and in Pompeii such hooks were found among exhumed instruments.

In the eleventh century Avicenne,² a celebrated Arabian obstetrician, employed hooks when manual extraction failed, and expressed the possibility of extracting a living child with them. Ambrose Paré (1549) constructed three hooks with which to perform delivery. And in 1554, Jacques Rueff³ of Zurich invented, among other instruments, his *forceps longa et versa*, with the declared intention of delivering a living child.⁴

¹ *Georgic*, Liber iv. 173–175.

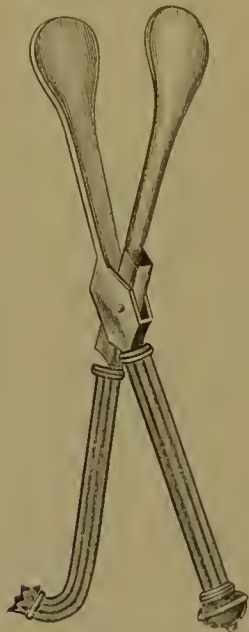
² Ed. 1608, p. 942.

³ Chereau: “Forceps,” *Dict. d. Sciences médicales*, Paris, 1877.

⁴ Aveling (*The Chamberlens and the Midwifery Forceps*, London, 1882) denies the merit of Rueff’s invention, claiming that he selected his forceps, with other instruments, from craniotomy instruments already existing. Aveling likewise rejects Palfyn’s claim as an inventor.

This was the first expression of the inoffensive and conservative function of the forceps. Shortly after, in 1561, Franco invented a valved tractor, resembling a speculum, designed for application to the head of the child without destroying its life. It will be observed that Rueff's forceps (Fig. 7) possessed in an undeveloped form the essen-

FIG. 7.



Rueff's Forceps (1551), after Chereau.

tial characters of the modern instrument. The cephalic portion of the blade was expanded to cover a considerable surface upon the head, the blades crossed, and the handles were adapted for a firm grip. But the merit of his invention lay in the establishment of the forceps as a conservative instrument. Up to this time the arrival of a "man-midwife" had boded the death of child or mother, or both, as he was never summoned until natural delivery failed, and his only resource, in head presentations, was the hooks so fatal, at best, to the child. The seventeenth century, however, was destined to bring to the notice of obstetricians the celebrated Chamberlen (or Chambellan) family, English obstetricians for three generations. Pierre Chamberlen (1601-83) received degrees at Padua, Oxford, and Cambridge, and was physician-in-ordinary to royal personages of England. He was a facile inventor in various fields, and communicated to his sons, Hugh, Paul, and Francers,

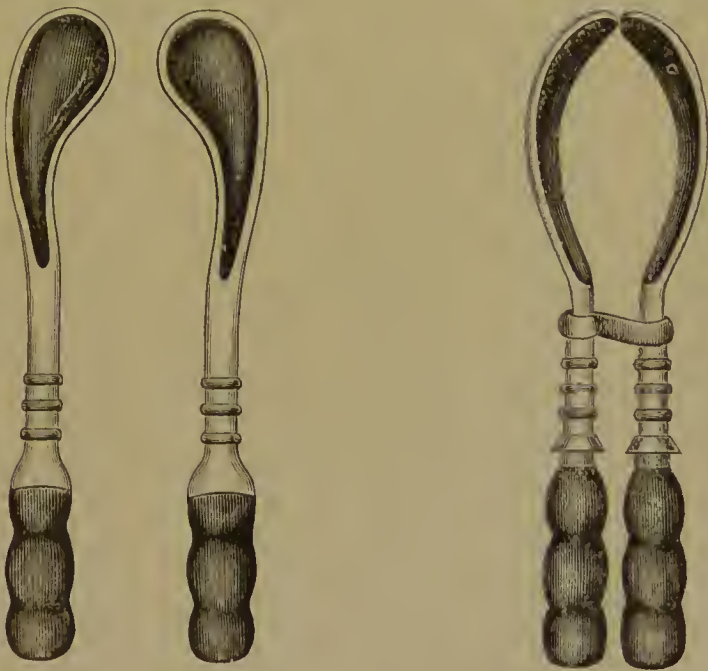
obstetricians, the knowledge of the Chamberlen forceps. Hugh Chamberlen visited Paris in 1670, hoping to realize a fortune by the invention. He sought Mauriceau, a famous obstetrician of that day, and begged a trial of his instrument. He was given a case of contracted pelvis, which he asserted he would deliver in a quarter of an hour. After three hours of violent effort he desisted from exhaustion. Mother and child did not survive twenty-four hours, and post-mortem examination revealed a ruptured uterus. With surprising boldness he revisited Paris six months after this failure, and proposed to sell his secret to the prime minister for a large sum. His reputation was not savory in Paris, and he returned to London, where he shortly afterward published a translation of Mauriceau's *Observations sur la Grossesse*, in which he claims the forceps as the invention of his father, his brothers, and himself. He also proposes to keep this invention a family secret.

Resolved to seek a new field of gain, Chamberlen visited Amsterdam in 1693, and sold his secret to Roonhnyen at a large price. The latter succeeded in carrying on a monopoly of the forceps in Amsterdam for sixty years (1693-1753). In 1747 he obtained a municipal decree

obliging every practising obstetrician in Amsterdam to purchase the secret, and with his associates formed an autocratic medical association which ruled obstetric practice without compunction.

Meanwhile, a forceps resembling the Chamberlen instrument was in process of introduction and use by Drinkwater, an English physician (1668), by Van Salingen at The Hague, and Slevogt of Jena (1709). Chamberlen is mentioned in 1697 as having delivered a child with his *speculum matricis*, probably his forceps.¹ In 1716, Palfyn, a Dutch surgeon, exhibited to the Academy of Sciences of Paris a forceps of his invention, often styled "Palfyn's hands." It was severely condemned by La Motte, a contemporary authority, but the blades were joined by Heister of Altdorf in 1739, and it was highly esteemed by him and others. A plea for priority in the invention of the forceps has been entered in favor of Palfyn, but it is difficult to assign an absolute priority to any one in the invention of an instrument so gradually

FIG. 8.



Palfyn's Forceps, joined by Heister (Chereau).

developed and by so many different men. That Palfyn's forceps, as joined by Heister (Fig. 8), was fairly efficient, and recognized and used as a conservative instrument, there can be no doubt. The problem of joining the blades was also solved by Dusée (1733), who was the first to provide an efficient fastening by means of a mortise with a pin, after crossing the blades. In 1734, Giffard and Chapman fenest-

¹ Chereau : *loc. cit.*

trated the cephalic portion of the blades,¹ and Chapman wrote in defence of the use of the forceps in 1735.²

The Amsterdam monopoly justly came to grief in 1732 through Rathlaw, an obstetrician of Amsterdam, who refused to purchase the secret of Roonhuysen. He communicated his grievance against the monopoly to a friend, a physician at The Hague, and he in turn, by questioning a former student of Roonhuysen, discovered the secret. The student, Van der Swam, had lived with Roonhuysen in 1697; his curiosity regarding his master's secret had impelled him to make frequent efforts to examine the forceps, but without success. While attending a case Roonhuysen was summoned by the burgomaster, and,

FIG. 9.



Rathlaw's Forceps
(1732).

putting his instruments in a bag, he hastily concealed them. He had been observed by Van der Swam, who opened the bag in his absence and took the design of the forceps.³

Rathlaw's "tire-tête" (Fig. 9), made by him in Paris in 1732, was a modified Chamberlen-Roonhuysen forceps. A wordy war between Roonhuysen and Rathlaw ended in the triumph of the latter in 1747 and the permanent defeat of the Amsterdam monopoly.

In addition to his labors with the forceps, Roonhuysen sought to enrich the armament of the obstetrician by a vectis, but even this is assigned by critics to his son-in-law Bruin, and there remains to him only the doubtful glory of a participation in the conscienceless enterprise of Chamberlen.

All doubt as to the exact form of the Chamberlen forceps was cleared away in 1818 by the discovery of hooks and instruments formerly the property of the Chamberlens at a house in Essex occupied by them from 1633 to 1715. Among other instruments Carwardine found four models of the forceps.⁴ It will be seen (Fig. 10) that Chamberlen had constructed an instrument closely resembling the short forceps of the present day. Had cupidity and selfishness not ruled his actions, he might justly have claimed one of the noblest achievements in medicine: as it is, he furnishes an example of shameless greed which has earned the condemnation of the majority of medical historians.

Until 1747 the forceps possessed only the cephalic curve, but at this time Levret invented at Paris a forceps, longer than that ordinarily used, to which he gave a pelvic curve. His model has been generally

¹ *Cases in Midwifery*, London, 1754.

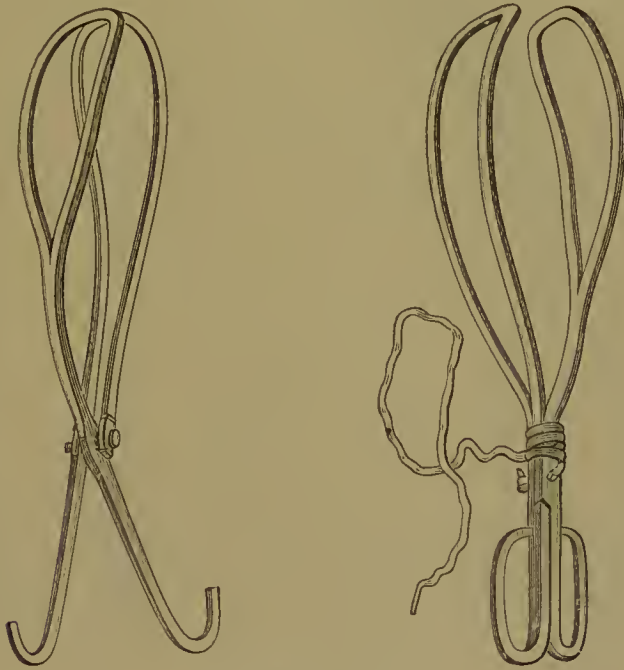
² *A Treatise on the Improvement of Midwifery*, London, 1735.

³ Chereau: *loc. cit.*

⁴ *Medico-Chirurgical Transactions*, vol. ix.

retained by French obstetricians to the present day. Levret (Fig. 11) made no attempt to cover the iron, but roughened the handles for a firmer grip. In 1752, Smellie lengthened the forceps in use in England, covered the handles with wood and the remaining portion with

FIG. 10.



Chamberlen's Forceps.

leather, and joined them by the lock which appears at present in the Simpson forceps. He retained the short forceps (Fig. 12), and considered its use very desirable in delayed labor, urging that short forceps could be applied often without the patient's knowledge, as the fear of operative interference was very great. Smellie hoped to popularize the instrument by his short forceps, thus removing one of the great obstacles to the acquisition of skill in its use.

The gradual extension of the knowledge and use of the instrument was such at this period that modifications followed each other with great rapidity: as many as fifteen different models of forceps, devised in the year 1833, represent the greatest inventive activity.

The need for long forceps was felt by Levret and Smellie; the dangers attending the application of the forceps at the pelvic brim were recognized by Smellie; and axis-traction was perhaps foreshadowed by Stein of Cassel (1767), who prolonged the fenestræ of his long forceps toward the lock, that he might pass through this space a band of pliable material, and thus make more advantageous traction.

A forceps with the English lock and a moderate pelvic curve was

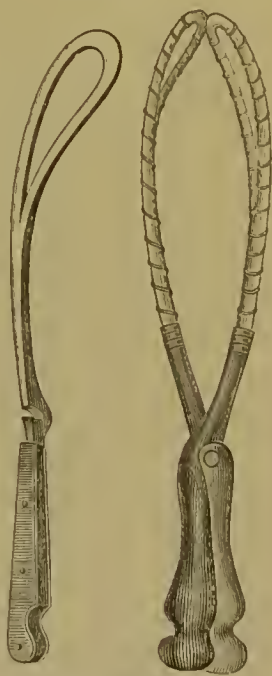
introduced in Vienna by Boër (1793), and continued in use for many years in the Vienna Hospital. In 1802, Brünnighausen invented the

FIG. 11.



Levret's Forceps.

FIG. 12.



Smellie's Forceps (Lusk).

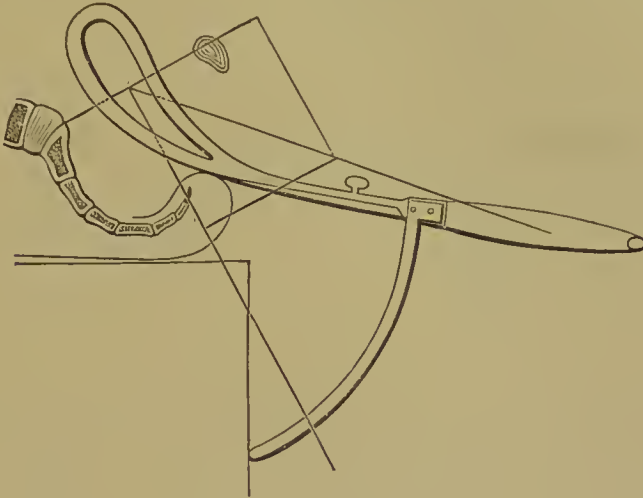
German lock, which exists at present as modified by Naegele. Among the curiosities called forth by this period of invention was a forceps called Audibert's "aids to memory," containing, engraved upon the handles, the pelvic diameters and various useful data; and also Bernard's *forceps assemblé*, intended for the simultaneous introduction of both blades. In 1801, Thenance of Lyons constructed the Lyons forceps, parallel, joined by a band near the usual location of the lock, and further united by a metal fastening at the extremities of the handles; they remained in use at Lyons for many years. Assalini (Milan, 1811) devised similar parallel forceps. Naegele in 1853 perfected the lock and forceps which bear his name, and gave the German obstetricians their favorite instrument.

But the problem of the direction in which traction should be made when the head failed to descend continued to arouse the efforts of obstetric inventors, and in 1867, Hamon devised a retroceps for preserving and perfecting flexion by grasping the occiput. He was preceded by Hubert (1860), who invented an axis-traction instrument in which the axial force was applied by a bar extended in the arc of a circle perpendicularly downward from the handle near the lock (Fig.

13). In 1868, Morales devised a forceps possessing a perineal curve in addition to the usual cephalic and pelvic curves.

It remained, however, for Tarnier (1877) to present to the Academy

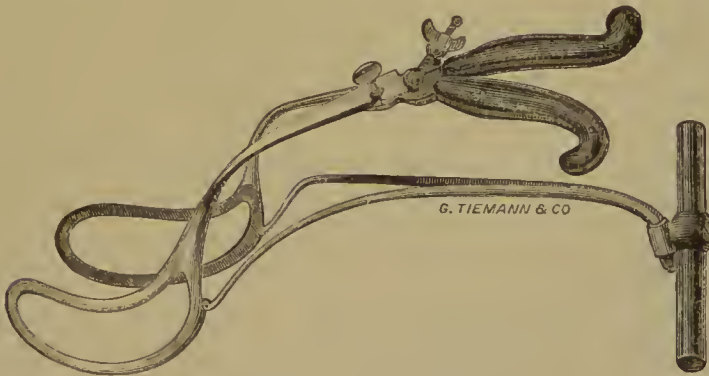
FIG. 13.



Hubert's Axis-traction Forceps.

of Medicine of Paris the forceps which bears his name, and which is most used at the present time for axis traction. His original model (Fig. 14) possessed three curves, a pair of curved traction-rods, and,

FIG. 14.



Tarnier's Forceps, first model.

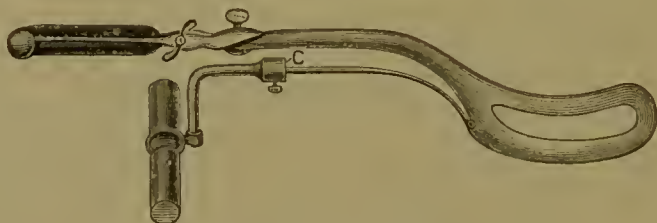
in addition to the usual French lock (with mortise and pin), a device for regulating the compression of the child's head. He has subsequently abandoned the perineal curve in his later instruments (Fig. 15).

The History of the Forceps in America.—As might naturally be expected, the forceps first used in America was that brought from England and France. It does not appear that the aborigines possessed any instrument for accelerating delivery resembling the forceps, and

their efforts were confined to changes of posture and external pressure (Englemann).

Obstetricians were gradually divided into two classes by their views regarding the principles governing the application of the forceps. Those who applied the blades to the sides of the pelvis, grasping the head without regard to the relation between the forceps and the cephalic

FIG. 15.



Tarnier's Forceps (modified).

diameters, adopted the Smellie-Simpson model, while those who adopted the six cephalic positions of Baudelocque endeavored to accommodate the instrument to the head in its various positions. Hodge's forceps, justly styled by its inventor "the eclectic," was constructed on the model of Baudelocque, and represents the practical application of the belief that the forceps should be applied to the head and not along the pelvic walls.

Elliott and Bedford have popularized the Simpson model; the studies of Davis of London in perfecting the cephalic portion of the blades have modified American instruments, as is seen in the forceps of Wallace and the short instrument of Sawyer. Axis traction has been chiefly effected by the long forceps ordinarily used; Tarnier's forceps has been modified by Lusk. Minor modifications have been made in abundance, but they have served for little else than to attract attention to the names of their authors. Indeed, Parvin¹ mentions an "original" forceps which figured with its inventor's name in a text-book, but never passed beyond the shape of illustration, its actual construction never having occurred.

FORCEPS OF THE PRESENT DAY.—A brief illustration of the forceps in use at present by the greater number of obstetricians in different countries will be useful in explaining the origin of American models.

The short, straight forceps, after Chamberlen's model, is most used in England. In America this instrument is used infrequently, Simpson's and Sawyer's short forceps, of this variety, being chiefly employed. Long forceps, possessing the pelvic curve of Smellie and Levret, are in general use among obstetricians of various nations. By the term "forceps" is commonly understood in America various modifications of

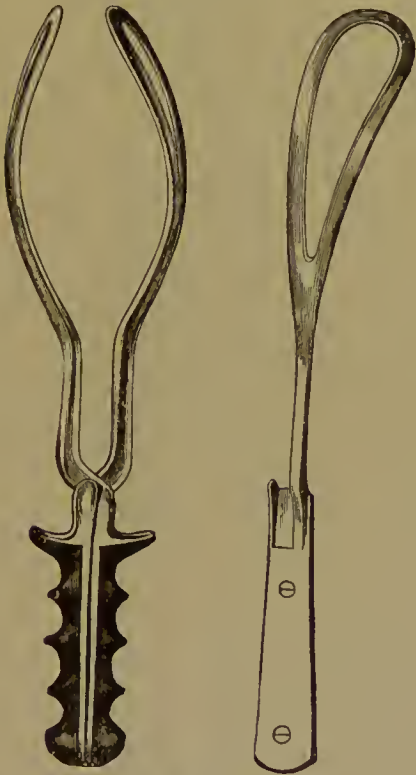
¹ *Obstetrics*, 1886, footnote p. 618.

these original long models. The number of such modifications, devised to satisfy the preferences of operators, is so great that for practical purposes only typical instruments can be described.

The English instrument most esteemed is that of Simpson. The cephalic portion of the blade is $6\frac{1}{4}$ inches long, the fenestra $1\frac{1}{4}$ inches wide. The blades are 1 inch apart at their tips when closed, and 3 inches at their widest portion; the object of this width is to lessen the compressing power. The pelvic curve is not great, to allow rotation of the head. Between the cephalic portion of the blade and the lock is a straight portion or shank $2\frac{3}{8}$ inches long, bent at right angles at the handle. The purpose of this knee so formed is to bring the lock without the maternal genitalia: the operator's finger may be also placed above the lock to aid in traction. Two projecting rests below the lock afford an additional security of grasp.¹ Simpson's forceps is a favorite

with many Americans. Lusk has habitually used and recommended the original model of this instrument.² For axis traction Simpson has modified Tarnier's instrument:

FIG. 16.



Simpson's Forceps.

FIG. 17.



Simpson's Axis-traction Forceps: a, b, traction handle; c, f, line of traction.

the general form is that just described; the traction-rods are fixed upon the instrument.

The Naegele forceps is most used in Germany, although Simpson's is frequently employed, especially in Braun's modification. The Naegele

¹ Playfair: *The Science of Midwifery*, 1885.

VOL. II.—9

² *Midwifery*, 1886.

forceps resembles Smellie's, but is noteworthy for its lock, which is that of Brünninghausen: this consists of a pivot upon which is a flat button fitting into a notch upon the opposite blade. This forceps is at present made entirely of metal, with carefully rounded edges and without crevices in which septic matter might accumulate.

FIG. 18.



Naegele's Forceps.

FIG. 19.



Breus' Axis-traction Forceps.

The German axis-traction forceps is that of Breus, the traction-rods of which are hinged upon the posterior extremity of the cephalic portion of the blade, and are non-detachable.

The forceps ordinarily used in France is modelled upon Levret's, as exemplified in Pajot's and Stoltz's. For axis traction Tarnier's well-known instrument has not only been adopted by the French, but has been extensively used by others. As most recently constructed it is without the perineal curve. This instrument is known to Americans through Lusk's modification.

Other nations adopt the model advised by the school of obstetrics whose teachings are followed, and these are usually the instruments

described. Parallel forceps have been principally constructed and recommended by the Lyons School and by Lazarewitch:¹ they have not found wide adoption.

Hodge's, Wallace's, Elliott's, and Smith's may be taken as types of American forceps. Hodge's instrument was constructed upon the belief

FIG. 20.



Lusk's Tarnier Forceps.

FIG. 21.



Hodge's Forceps.

FIG. 22.



Wallace's Forceps.

that the obstetrician will do best with a forceps suitable for application at any portion of the pelvis, and to which he is accustomed.² The possessor of a good long forceps absolutely needs no other—an opinion shared by the majority of obstetricians. Hodge based his forceps upon Baudelocque's model, added Siebold's lock, and made the instrument light and graceful. The cephalic portion of the blades is carefully adapted for application to the child's head and at the brim of the pelvis. The blade is 16 inches long; the cephalic portion 6 inches in length, with fenestra $1\frac{1}{2}$ inches wide: the shanks are 4 inches long. This forceps should weigh 17 ounces.

¹ *Proceedings Ninth International Medical Congress, Washington, 1887.*

² *System of Obstetrics.*

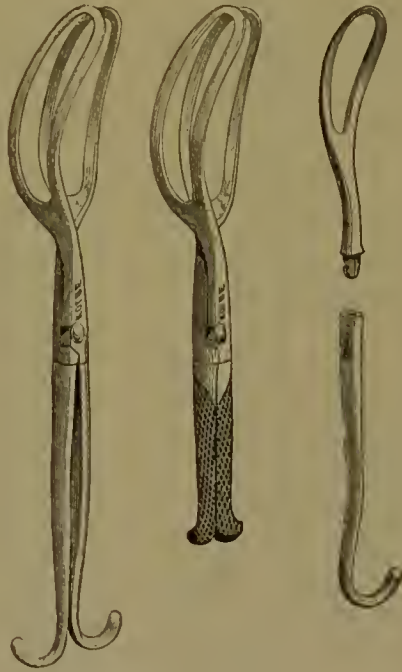
The Wallace forceps combines the blades of Davis of London, which were the result of very minute adaptation to the child's head, and the handles of Hodge's forceps, with a lesser curve. It is 1 inch shorter than Hodge's forceps, with more open fenestræ and shorter shanks, giving greater compressing power: its lock is the same and its weight greater. Elliott's forceps is a modification of Simpson's, 15 inches long, and differs from Simpson's forceps chiefly in the omission of the projecting shoulders upon the shanks; it possesses also a pin fitted between the ends of the handles, to prevent undue compression of the head. It is intended for application to

FIG. 23.



Elliott's Forceps.

FIG. 24.



Smith's Forceps.

the sides of the pelvis in the majority of cases. Smith's is a modification of the Davis forceps, made more easily portable by a pivot and ratchet in each handle, permitting them to be taken apart. Two sets of handles are provided, longer and shorter, for use as compression may or may not be required. The forceps of Holt, Reamy, and Miller present various points of comparative excellence, and have obtained local celebrity. Sawyer's short forceps is the principal American instrument of its kind; it weighs but 5 ounces, measures $9\frac{3}{4}$ inches in length, and combines the blades of Davis, the shanks of Hodge, and Smellie's lock, with hard-rubber plates upon the handles.

Among the various applications of the principle of axis traction, the

effort to substitute flexible tractors for the ordinary metal rods has proven fairly successful. Snger has passed flexible bands through the posterior extremities of the fenestræ, and thence through a rubber ring encircling the forceps at the handles; these bands terminate upon a transverse handle below the lock. Depaul has devised an apparatus of cloth consisting of a band encircling the head, to which are attached four tractors; the band is adjusted upon the head by a long flexible rod and is then laced firmly. This device he has styled the *sériceps*.

Poulet has overcome what he considers defects in Tarnier's forceps by perforating the cephalic portion of the blades at the junction of the posterior two-thirds with the anterior third, passing traction cords through these apertures, which terminate in a handle resembling Tarnier's. It is evident that the simplicity of this device, and the ease with which it may be added to any long forceps with which an obstetrician may be familiar, commend it for more extensive use. It is claimed that traction by this means leaves the head free to mould itself to the pelvis and to follow in the best possible manner the pelvic axis.¹

Stevenson of London, at the meeting of the British Medical Association, August, 1888, presented a forceps resembling Simpson's very closely. As an accompaniment he had devised a blunt-hook tractor which he hooked over the lock, thus making downward traction in the pelvic axis.²

It is evident that the ingenuity of the obstetrician must solve problems in traction with the forceps as they arise. In common with other instruments used in medicine, that device is best which is simplest and which is most perfectly under the control of the skill and intelligence of the operator.

Good forceps, whether long or short, should be made of well-tempered steel, nickel-plated, with rounded edges and with smooth hard-rubber or metal handles; a corrugated handle is objectionable as affording lodgment for septic matter. The pelvic and cephalic curves should be those of one of the approved models described. The instrument should be sufficiently heavy to be firm; the lock should be easily

FIG. 25.



Sawyer's Forceps.

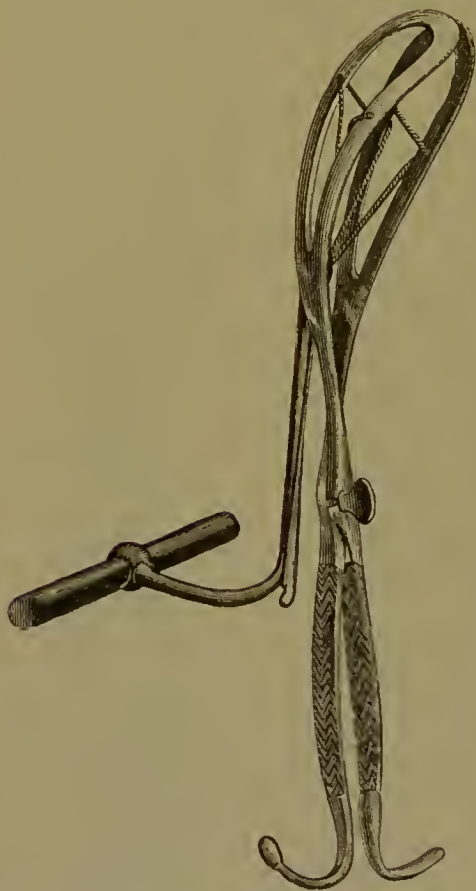
¹ Poulet: Thèse, *Des Diverses Espèces de Forceps*, Lyon, 1883.

² The writer is indebted to Professor Parvin, who has recently brought it from Europe, for permission to examine and represent this instrument.

adjustable and secure; many operators prefer a lock which permits easy separation of the blades and a slight rocking motion.

THE FUNCTION OF THE FORCEPS.—The forceps is primarily a tractor, a reinforcement of *vis à tergo* by *vis à fronte*. Its functions as

FIG. 26.



Poulet's Axis-traction Forceps.

FIG. 27.



Steavenson's Device for Axis Traction.

a compressor, rotator, and lever are secondary and incidental, as is its office in preserving the perineum from rupture.

INDICATIONS FOR THE USE OF THE FORCEPS.—Failure or delay in the action of the mother's expulsive forces is the most frequent indication for the forceps. In keeping with its conservative function, it may be said that any cause necessitating prompt delivery, when certain conditions are fulfilled, calls for the forceps in the interests of mother and child. Failure or delay in the expulsion of the child may be caused by imperfect maternal nervous and muscular development; exhaustion from long-continued efforts necessitated by mechanical obstacles to delivery or caused by chronic anæmia and wasting diseases; loss

of blood, as in placenta prævia, causes failure of expulsion and calls for the forceps.

Mechanical obstacles to delivery must be relative and not absolute, however, to justify the use of forceps. The form of mechanical obstruction most clearly an indication is rigidity of the maternal tissues. This, by gradually exhausting the peristalsis of the genital tract, results in the delay of the head, pressure followed by engorgement of both maternal and foetal tissues, with impending necrosis, and, when tissue so engorged becomes infected, in general septic infection.

CONDITIONS JUSTIFYING THE EMPLOYMENT OF FORCEPS.—It is generally held that a cephalic presentation of the foetus is a necessity. Tarnier, however, rejects the blunt-hook in breech presentations when the hook cannot reach the feet, and applies his axis-traction forceps to the breech. The instrument is absolutely contraindicated in other presentations.

The membranes should be ruptured, and also retracted over the head, as traction upon the membranes will tear away the placenta. The external os uteri should be so far dilated and retracted that its edge can be scarcely reached by the examining finger.¹ It is also said that the os must be as large as the palm, or at least larger than an American silver dollar. It is evident that the actual size of the os uteri is not the only essential, but that the degree of elasticity of the os and cervix and the size of the head are important factors in justifying the application of forceps. There must be no mechanical obstacle to delivery in the maternal parts not surmountable without the exercise of great force.

On the side of the foetus hydrocephalus forbids the forceps. The head of the foetus and the birth-canal of the mother must be proportionate in size. The head must have moulded itself to the pelvic canal; in other words, must engage. As a rule, the smaller fontanelle must be directed anteriorly. In point of time Pajot believes that when the head has remained stationary for two hours upon the pelvic floor instrumental delivery is indicated. Here, again, judgment must be exercised. It is not the exact length of time, but the degree of compression to which soft tissues are subjected and the effect produced, which justify interference. The head of the foetus must be not only of proportionate size, but of normal consistence; the head of a macerated foetus or the perforated head after craniotomy should not be delivered with forceps.²

The application of the forceps to save the time and promote the convenience of the obstetrician is not to be commended. The conservative function of the instrument is to be clearly kept in mind, and its employment strictly limited to the fulfilment of that function.

¹ Schroeder: *Lehrbuch der Geburtshülfe*, 1886.

² *Ibid.*: *loc. cit.*

THE APPLICATION OF THE FORCEPS.—It is important that an accurate diagnosis of the presentation and its position should be made before proceeding to the application of the forceps. In addition to abdominal palpation, a vaginal examination should be made just before the introduction of the instrument, and this should be unusually thorough. Two fingers, or enough of the hand to determine the position, should be employed. Forceps cases are prolonged, and the patient is usually subjected to more frequent examination than in normal labor. Especial attention should therefore be given to the preservation of an aseptic condition of the vagina and cervix. A hot vaginal douche of dilute bichloride solution, 1 : 4000, should be employed before the vaginal examination made for diagnosis. The hands and forearms of the operator should have been scrubbed with soap and hot water, rinsed in clean water, and washed in bichloride solution, 1 : 1000. The forceps should be cleansed with soap and hot water and with a 5 per cent. solution of carbolic acid. To lubricate the blades glycerin and carbolic acid, 3 per cent., or carbolized vaseline, 5 per cent., should be used, the blade being anointed upon the surface next to the maternal tissues only.

In common with the majority of European operators, Americans prefer to place the patient upon the back: the English choose the position on the left side. It is well to inform those of the patient's family attending her of the intended use of the forceps; it is generally sufficient to remark to the patient that help is about to be rendered in a safe and speedy way, her part in the ending of her sufferings being the necessary change of position and the inhalation of an anæsthetic. Ether is commonly used in America, although chloroform is employed in other countries with the greatest advantage. In women unusually self-possessed, in whom delivery will be comparatively easy, an anæsthetic may be dispensed with; but in the majority of forceps cases it should be used, and its administration should be entrusted to a reliable physician whenever possible. In hospitals an operating-table for the delivery of difficult cases may be used to advantage. In private practice the patient, when anæsthetized, should be placed comfortably across a bed, which should not be too low, her hips brought well over the edge, the legs being wrapped in blankets and held by assistants; when help is limited they may be placed on chairs. The obstetrician should sit or stand directly before the patient, taking care that her pelvis is directly opposite him, and that it remains as much as possible in this position.

Having assured himself that the rectum and bladder are empty, the operator should proceed to introduce and lock the instrument. For practical purposes the blades of the forceps are known as left and right, as they are introduced upon the left and right sides of the mother. Hence Pajot's familiar rule—the left blade to be taken in the operator's

left hand, and introduced on the left side of the mother's pelvis. Enough of the right hand, preferably the four fingers, should be inserted in the vagina and cervix and passed between the head and the cervix uteri to effectually guide the entering blade. Grasping the left blade near the lock with the left hand, the operator allows it to glide along the palmar surface of the right hand, depressing the handle as it proceeds. Failure to enter easily calls for readjustment of the right hand, preceded by the withdrawal of the blade. When the left blade has adjusted itself to the head, as it should do easily, it may be lowered, and the hand of an assistant placed upon the handle to prevent its expulsion during a uterine contraction. The left hand should then be inserted upon the mother's right side, and the right blade similarly introduced, above the left. If the forceps grasps the head in its biparietal diameter, the blades will easily lock. If this is not the case, the blades may be slightly withdrawn or advanced, or their position slightly altered, when a second effort to lock should be made. If the forceps will not lock without considerable force, the obstetrician has reason to fear that the presentation is not occipito-anterior. In this event the instrument should be withdrawn, and the obstetrician should take advantage of the patient's anæsthetized condition to re-examine her; and should the presentation not be occipito-anterior, he may rectify it by manipulation or decide upon further procedures.

The application of the forceps calls for gentleness and due deliberation, and the danger of including maternal tissue in its grasp should be kept in mind. It has been urged that this danger is lessened by allowing the mother to remain conscious, as her complaint of pain on traction would indicate violence done to her tissues. As she will naturally experience increased pain when the head advances, the operator should not rely upon this indication of improper adjustment, but should satisfy himself of the proper performance of his own manipulation.

Before discussing traction with the forceps it is expedient to classify to some extent the various presentations and pelvic conditions which justify its use.

Forceps cases naturally divide themselves into those in which the mother's birth-canal and the foetal head are proportionate in size, and those in which they are disproportionate. From the side of the foetus, cases requiring the forceps may be divided into those in which descent and rotation of the presenting part occur normally, and those in which they do not occur. It is evident that the full discussion of the second topic will open the field of choice between the forceps, version, craniotomy, and Cæsarean section.

THE FORCEPS WHEN THE HEAD AND THE BIRTH-CANAL ARE
PROPORTIONATE IN SIZE.

IN OCCIPITO-ANTERIOR POSITIONS, DESCENT AND ROTATION HAVING OCCURRED.—This represents the most simple case demanding instrumental aid. Recalling the mechanism of normal labor, it will be remembered that the foetal head is expelled from the vagina by the contraction of the abdominal muscles of the mother, aided by the comparatively feeble force of the partially emptied uterus. The trunk of the foetal body would remain in the genital canal were it not for the expulsive action of the abdominal muscles.¹ It will be readily seen that a patient whose abdominal muscles are poorly developed will fail to expel the foetus from the genital canal, especially if the perineum be rigid and the peristalsis of the genital tract be exhausted. These are the cases met with among the well-to-do when forceps must be used to terminate a labor otherwise normal. Traction in such cases consists in bringing the occiput well under the pubes, maintaining flexion and allowing extension to occur slowly and with as little danger to the perineum as possible.

FIG 28.



Forceps at the Inferior Strait (Hodge).

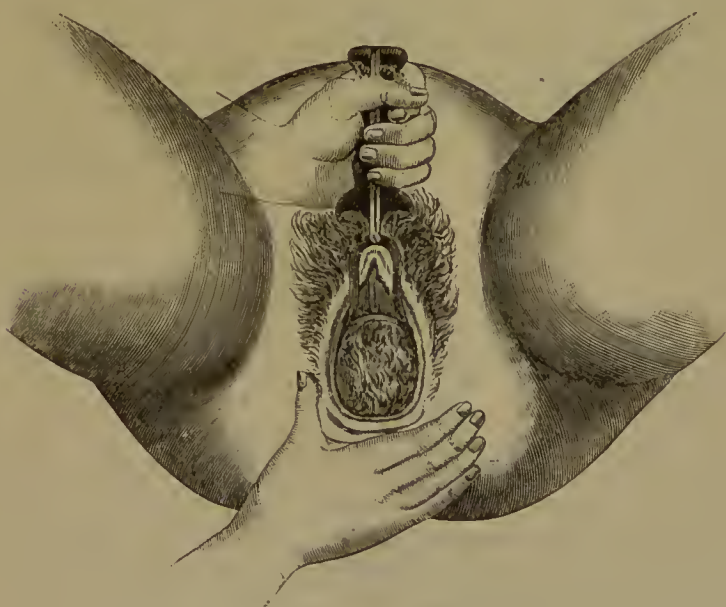
For the preservation of the perineum the simple procedure of incising laterally the attenuated tissues at the lower third of the vulvar are is often of considerable practical value. Episiotomy has been considered by some American writers on obstetrics as a fit procedure for amateurs, but in the hands of skilled obstetricians in the Vienna General Hospital the writer has frequently seen perineæ saved by this simple expedient; and the teaching of these operators is that it is a resource of undoubted value. Traction in these cases will be first downward, then horizontal, until the occiput projects from the vulva, when the face may be lifted cautiously over the perineum. Traction should be intermittent, and between tractions the grasp of the forceps upon the head should be

¹ Schroeder: *op. cit.*

relaxed to prevent compression. Traction should be synchronous with uterine and abdominal muscular contractions: unless these are too infrequent, it is well to have an assistant standing beside the patient steadying the uterus and pelvis and exciting the abdominal muscles and uterus to action by moderate compression or friction.

In cases where the head has not reached the perineum, but descent and rotation are nearly completed, many prefer to bring the head well down upon the perineum by forceps, thus rousing the expulsive forces through reflex nervous stimulus from the distended tissues, and then remove the forceps, allowing the expulsion of the head to follow. If the abdominal muscles are not deficient or exhausted, there can be no objection to this practice; but unless the obstetrician can expect that the final effort of parturition will be a vigorous one, he will do well to complete the labor instrumentally. The force requisite for delivery under these circumstances is a very moderate one; and the exceptional functions of the forceps, compression, leverage, and rotation, are not required. The operator may stand at the patient's right side during the emergence of the head, grasping the forceps with the left hand, while his right hand supports the perineum, or the same manipulation may be performed

FIG. 29.



Protecting the Perineum in Forceps Delivery (Lusk).

while standing before the patient. It is in these cases of muscular inertia that the short forceps is preferred by many obstetricians.

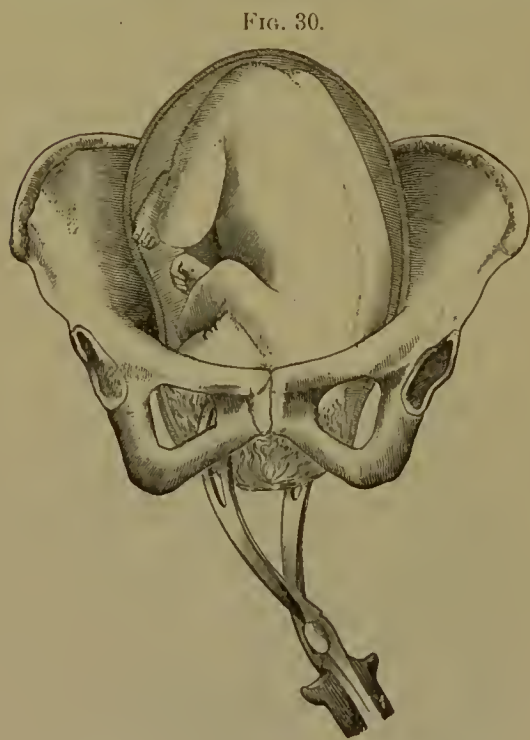
FORCEPS IN OCCIPITAL PRESENTATIONS, WHEN ANTERIOR ROTATION FAILS.—In normal labor anterior rotation is effected by the

inclined planes of the pelvis, the resistance of the pelvic floor, and the expulsive forces of the uterus and abdominal muscles. When, through the deficiency of any of these factors, rotation fails, labor is delayed, and the interests of mother and child may demand instrumental delivery. The question then arises, Shall the forceps be applied along the sides of the pelvis and in its axis, grasping the head as best it may, or, shall the instrument be fitted to the head, being introduced obliquely in the pelvis?

The experience of many competent obstetricians has proven that the forceps may be applied along the sides of the pelvis and a living child delivered without damage to fœtus or mother, provided the grasp of the

instrument be relaxed when tractions are not in force, and the head be allowed to mould itself and rotate spontaneously. It is also true, however, that in cases where the head and the pelvis are of normal proportions the more skilful procedure is the oblique application of the forceps.

It is well to try simple means of effecting rotation before having recourse to instrumental delivery. The patient may be placed upon that side which is occupied by the vertex; any malposition of the uterus may be corrected: the hand introduced into the vagina is often an efficient means of effecting rotation. Any



The Forceps in Defective Occipital Rotation.

measure tending to give the mother a brief rest, thus increasing the expulsive forces, may be employed; a stimulant may be given, but in moderation. Should it be decided to apply forceps, and the position having been accurately diagnosticated, the instrument should be introduced in the oblique diameter of the pelvis opposite to that occupied by the head: Pinard's direction is to apply the blades at the extremities of the empty oblique diameter; and this diameter will be that in which the biparietal diameter of the head will generally be found. Exception may be made to the rule to insert the left blade first: Tarnier countenances the introduction of the blade which comes anteriorly

first, whether it be right or left. No rule, however, is invariable for abnormal cases, and the peculiarities of the individual case and the skill of the operator will decide the mode of application.

Especial care should be observed in introducing forceps obliquely that the maternal tissues are well guarded from its grasp. The function of the forceps as a compressor is to be exercised in these cases, but with decided moderation. Traction is made as in normal rotation, downward, horizontally, and upward. If care be taken to allow the head to mould itself by relaxing the grasp between traactions, injurious compression will be avoided and the head will gradually assume a normal position. Rotating or twisting motions with the forceps should be avoided, and pendulum or oscillatory traactions are contraindicated. The desired rotation will be best accomplished by the natural mechanism, the forceps playing the part of a reinforcement of the expellent forces. The forceps should rotate with the head, rather than the head be forcibly rotated by the forceps.

IN OCCIPITO-POSTERIOR POSITIONS.—Should the occiput rotate posteriorly, it would be the part of wisdom not to attempt its forcible rotation anteriorly by forceps. The effort of the obstetrician should be to imitate nature's delivery in these cases. A watchful delay in adopting instrumental interference is wisest. A healthy mother rarely fails to rotate the head anteriorly, and signs of exhaustion on the part of the mother and failure in the action of the foetal heart must be present before hope of spontaneous timely rotation is to be abandoned. When these indications are present delay should cease. The patient should be anæsthetized and the forceps applied to the sides of the child's head. Traction should then be made horizontally until the forehead appears beneath the pubes. The grasp of the forceps may then be relaxed to advantage: the handles should be lowered and a new grasp taken. The object of this manœuvre is to perform flexion over the perineum as the head emerges. The operator then clears the forehead from beneath the pubes, and flexes the head gradually until the occiput has passed the perineum and the head is born. Laceration of the perineum generally occurs in these cases, but the injury should not be severe and should be immediately repaired.

There are those who consider the application of the forceps in occipito-posterior positions as a doubtful expedient, and Penrose¹ describes a condition in which the foetal body is so firmly grasped by the uterus, the child's abdomen and thorax being anterior, that rotation of the occiput is impossible, because the trunk cannot rotate; he would resort to forcible rotation or craniotomy in occipito-posterior positions. The majority of obstetric authorities, however, favor the judicious application of forceps in these cases.

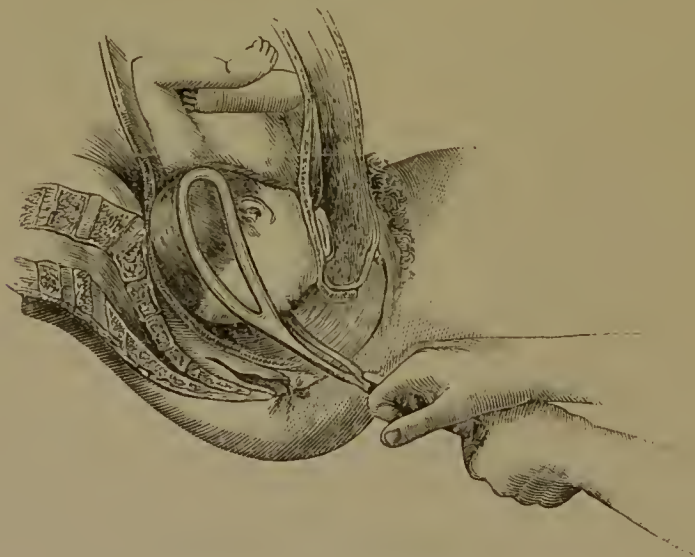
¹ *Lectures at University of Pennsylvania.*

In regard to the tolerance of rotation on the part of the fœtus, the rule that rotation of the head beyond a quarter of a circle is fatal to the child through injury to the spinal cord has been disproven by Tarnier, who has shown that torsion upon the fœtal head is not exerted upon the occipito-atloid ligament, but is distributed along the cervical spine: rotation beyond forty-five degrees often occurs in spontaneous delivery. Cazeaux and Ribemont confirm Tarnier's conclusions. Ribemont experimented upon frozen specimens, and observed that torsion was distributed along the cervical and dorsal spine, while the cord remained in the centre of the spinal canal and rotated upon its axis.¹

IN FACE PRESENTATIONS.—In face presentations the application of the forceps should be delayed as long as possible. When rotation occurs spontaneously, the blades may be applied to the sides of the head, care being exercised to grasp the head sufficiently far posteriorly to ensure a firm hold. Extension should then be maintained, and the mechanism of spontaneous delivery in this presentation should be imitated.

When rotation does not occur the utmost caution should be observed in using the forceps. All simple means should be employed to favor spontaneous rotation. A patient and thorough effort, with the parturient anæsthetized, should be made to rotate the chin anteriorly by the hand: it occasionally happens that when the head is not impacted the presenta-

FIG. 31.



Forceps in Face Presentation (Parvin).

tion may be converted into an occipital in the course of this manipulation. When the head fails to descend the forceps should not be applied

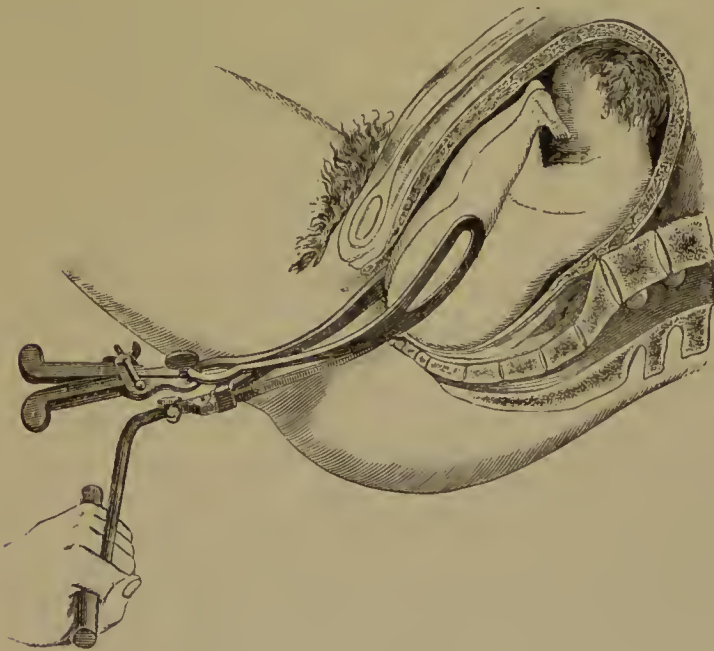
¹ Pinard: "Forceps," *Dict. Encyc. des Sciences méd.*, tome troisième, Paris, 1877.

when version is possible.¹ Carl Braun strongly condemns the high application of forceps in face presentations. When descent has occurred, but rotation is not properly accomplished, Schroeder advises the application of the forceps, when absolutely necessary, in such a manner that the concavity of the pelvic curve shall be directed toward that side of the pelvis to which the chin points: when the chin is toward the right side of the pelvis, the forceps should be applied in the right oblique diameter. The instrument should very rarely be applied when the face extends transversely across the pelvis: in favorable cases Carl Braun admits tentative traction, in the hope that rotation will occur; the forceps is to be removed as soon as the chin rotates, and reapplied if needed.

When the chin rotates into the hollow of the sacrum, the rule that forceps delivery is impossible and not to be attempted is very rarely to be disregarded. It is occasionally possible to imitate the delivery of an occipito-posterior position and draw the chin downward by narrow, straight forceps: Taylor's straight forceps has proven an efficient instrument in his hands in two such cases.² Others have rarely succeeded in this procedure, and it is most exceptional.

THE FORCEPS APPLIED TO THE BREECH.—The danger of injur-

FIG. 32.



Tarnier's Forceps applied to the Breech.

ing the abdominal viscera and genitalia of the fœtus has prevented the application of the forceps to the breech. With the introduction of his

¹ Schroeder: *op. cit.*

² *N. Y. Medical Journal*, Nov., 1869.

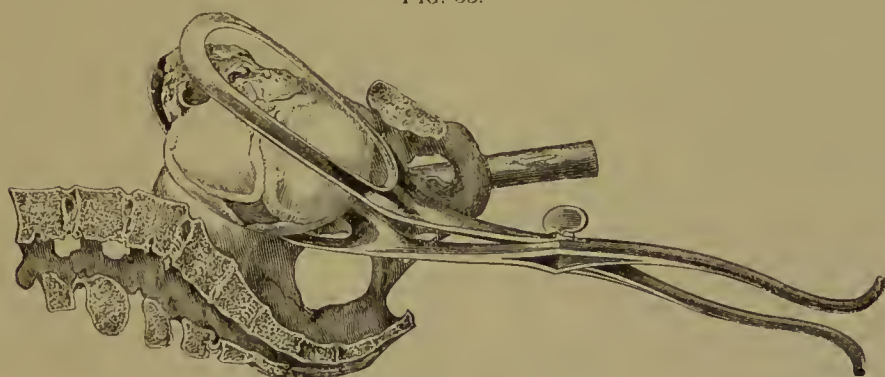
axis-traction forceps Tarnier has demonstrated the possibility of delivering the foetus safely by applying the blades in the iliac or trochanteric diameter of the pelvis. He has also applied his forceps in the sacropubic diameter, the genitalia occupying the fenestra of the blade, and extracted a foetus without injury. When the foetus lives, the instrument should grasp its pelvis in a transverse diameter. When the death of the foetus has occurred, the only precaution necessary is the obtaining of a secure hold with the forceps. Great gentleness in making traction is requisite, and in delivering a living child it is well to take every precaution against undue compression.

THE HIGH APPLICATION OF THE FORCEPS.—By this term we understand the application of the forceps to the presenting part situated at the superior strait of the pelvis. It is evident that this is a procedure attended by increased dangers to mother and child, and hence the conditions which justify the performance of the operation should be clearly determined. Failure of the head in these cases to accommodate itself to the pelvic canal is the cause of delay in labor, which results in gradual exhaustion of the expellent forces through ineffectual efforts to accomplish descent. This absence of accommodation may be caused by the malposition of a normal head through dislocation of the uterus, or by disproportion in the size of the head and that of the birth-canal. In the first instance the abnormal elasticity of the tissues following repeated parturition may result in anteversion of the pregnant uterus and the delay of the head in one of the iliac fossæ: at labor the weakened lower uterine segment may not possess sufficient firmness to resist excessive dilatation, and malposition of the head, with threatened rupture of the uterus, may result. In these cases the uterus should be replaced, and maintained in such a position that the direction of its axis favors descent. Efforts should be made by manipulation and the employment of the force of gravity to dislodge the head and favor its engagement. This will be best accomplished by anæsthetizing the patient and endeavoring by external manipulation to correct the position of the head. If success follows, pressure downward and slightly backward should be made above the pubes, and maintained for a sufficient time to give the head an opportunity to mould itself to the superior strait and to commence descent. If the head be dislodged and flexed, and pressure be made in the axis of the superior strait, the danger of injuring the lower uterine segment will be inconsiderable. Should engagement and beginning descent result, it is a fair conclusion that the head and the birth-canal at the superior strait are proportionate in size, and that the application of the forceps to the head as it has engaged at the superior strait will be successful and a conservative measure to both mother and child. These measures occasionally result in the resumption of the forces of normal labor and the spontaneous expulsion of the child. Should this

occur, the administration of a stimulant addressed to the nervous system will often facilitate delivery.

Should the high application of the forceps be indicated, the choice of an instrument is important. Operators in maternities or who have extensive consulting practice are accustomed to the use of forceps especially constructed for axis traction. The average practitioner may follow his profession for years without resorting to the high application of the forceps, and an axis-traction instrument may not be included in his armamentarium. The advantages of axis-traction instruments in skilful hands are undoubted. If, however, the practitioner is possessed of that combination of judgment, practical aptitude, and self-control which is so important to an obstetrician, he will find his long forceps sufficient for success. The American models of long forceps previ-

FIG. 33.



Forceps at the Superior Strait.

ously described are well adapted for axis traction, and have repeatedly proved competent for the exigencies of these cases. The assistance of a professional friend or intelligent nurse is especially desirable. Before applying the forceps the obstetrician should ascertain accurately by vaginal examination the position of the head. Antiseptic precautions, as already indicated, should be rigorously observed.

The head will generally be found engaged in an oblique diameter of the pelvis. The forceps should ordinarily be applied to the head, in accordance with the rules quoted. If, however, the obstetrician has been accustomed to apply his instrument to the sides of the pelvis, especially if he uses habitually Simpson's forceps or a modification of them, he will do well to follow his usual practice. Should the head, on vaginal examination, be found to lie in the transverse diameter of the pelvis, the mode of application of the forceps is questionable. The French admit rotation of the occiput forward with the forceps; the Germans do not apply the forceps until rotation has occurred; the English apply forceps to the sides of the pelvis—a procedure which is followed by the majority of Americans. This results, in the greater

number of cases, in the oblique adaptation of the blades to the head—the anterior near the coronal suture, the posterior over the parietal eminence.¹ If the forceps be applied to the head in an oblique diameter of the pelvis, the blades will lock with ease. If the head be grasped by the forceps at the sides of the pelvis, the blades will lock with difficulty. Sufficient compression should be made to ensure a firm grasp, and as delivery proceeds the blades will become properly applied.

Traction should be performed in the axis of the pelvis; and the determination of this axis has been attempted by the application of the principles of mathematics in the study of the bony pelvis. However valuable such investigations may be to the anatomist, for the practical obstetrician there is need of a knowledge of the axis and constitution of the birth-canal in the living mother. The studies of Braune, Schroeder, Bandl, Hofmeier and Benekiser, Pinard, Boissard, and Hart and Barbour have led modern obstetricians to regard the birth-canal as a cylinder whose axis extends at first downward and backward until it meets the sacral segment of the pelvic floor, which by the part that it plays in the dynamics of parturition turns the axis of the birth-canal to a direction upward and forward. The relation of the inferior uterine segment to the cervix, the pubic arch, and the superior uterine segment is important in the effort to avoid injury to the maternal tissues.

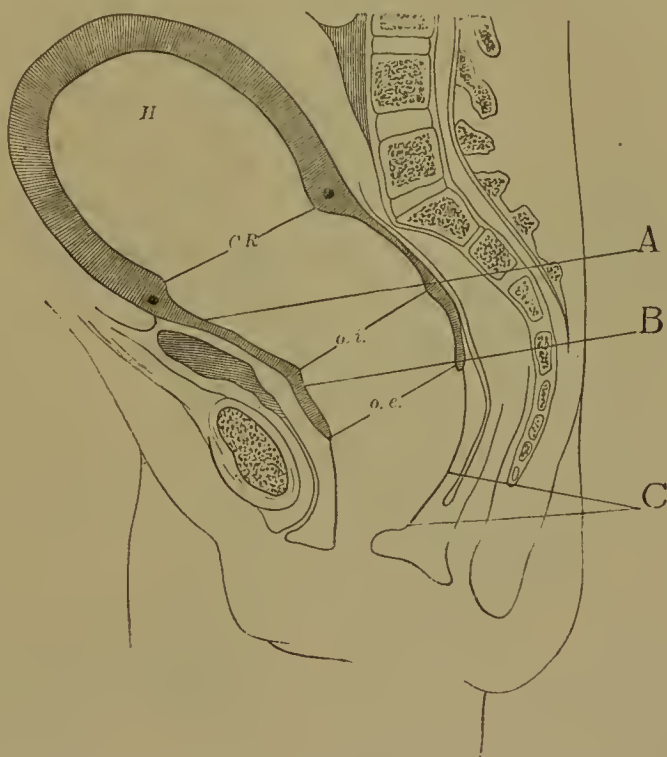
By reference to the accompanying illustration by Schroeder,² which is a schematic representation of the birth-canal based on his anatomical studies, it will be seen that the genital tract at parturition may be divided into a superior expulsive portion, composed of the muscular segment of the uterus, and an inferior elastic tract, comprising the inferior uterine segment, the cervix, and vagina. The axis of the expulsive portion extends downward and backward. The axis of the elastic division of the genital tract continues downward and backward, impinging upon the coccyx and sacral segment of the pelvic floor, whence it is deflected almost at right angles upward and forward. The forceps is applied to supplement the action of the expulsive portion; it must conduct the fœtus through the elastic division of the genital tract. As the presenting part engages at the superior strait, it is enclosed by the lower uterine segment, and often by a portion of the cervix. These tissues will be liable to injury from undue compression or from the projection anteriorly of the tips of the blades. Axis traction, then, should be made downward and backward until the head impinges upon the coccyx and the pelvic floor, when the direction should be upward and forward to lift the head over the perineum. The blades should be so applied to the head that they will not project beyond its circumference and injure the maternal tissues.

¹ Lusk: *op. cit.*

² *Lehrbuch der Geburtshülfe*, 1886, p. 153.

If the elasticity of the lower portion of the genital tract be deficient, the operator may be called upon to introduce the forceps through the partially-dilated cervix and inferior uterine segment. This complica-

FIG. 34.¹



The Birth-Canal at the End of the Stage of Dilatation (schematic; Schroeder): *H*, superior expulsive muscular segment; *C R*, contraction-ring; *o. i.*, os internum; *o. e.*, os externum; *A*, the inferior elastic uterine segment; *B*, the cervix; *C*, the pelvic floor.

tion adds very considerably to the dangers of delivery, and efforts to dilate the cervix by the hand or Barnes' dilators should be made before introducing the forceps. Rupture of the inferior uterine segment may occur, following long-continued pressure by the head and violent efforts at delivery.

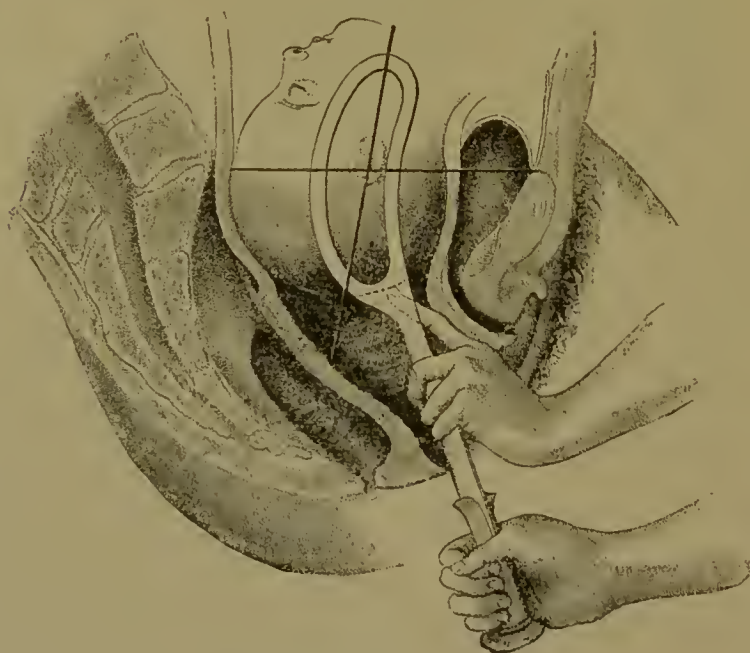
To effect axis traction with the ordinary long forceps the handles should be carried as far posteriorly as is deemed prudent. The operator's stronger hand may then be placed upon the handles at the lock as the fulcrum, while the other hand at the extremity of the handles uses the forceps as a lever. Dr. Albert H. Smith was an advocate of this mode of operating, in which he was expert. Pajot by a similar manœuvre makes the forceps a lever of the first or of the third order at pleasure. To perform this manipulation well requires strength and dexterity. Traction without it is fairly safe, and although force is

¹ Schroeder: *Lehrbuch der Geburtshülfe*, 1886, p. 153, Fig. 51.

wasted by pressure against the symphysis pubis, still children are not infrequently so delivered without great damage to the mother.

Tractions should be gradual, direct, and, during their intermittence, the blades should be slightly separated. Rotation will gradually occur, and will be completed when the pelvic floor is reached. While the

FIG. 35.

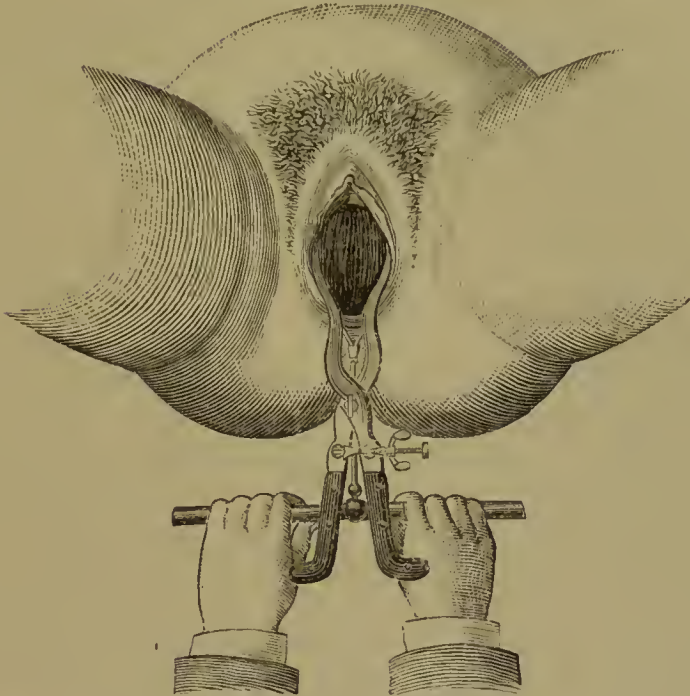


Smith's Axis Traction by Leverage.

forceps remains in apposition to the head during traction many prefer to partially unlock the blades between tractions, thus virtually making a new application with each step of rotation. Smellie's (Simpson) lock and Naegele's are especially well adapted for this purpose. It is very desirable that an assistant steady the uterus during tractions, maintaining its axis in the normal direction and stimulating it to contraction by massage.

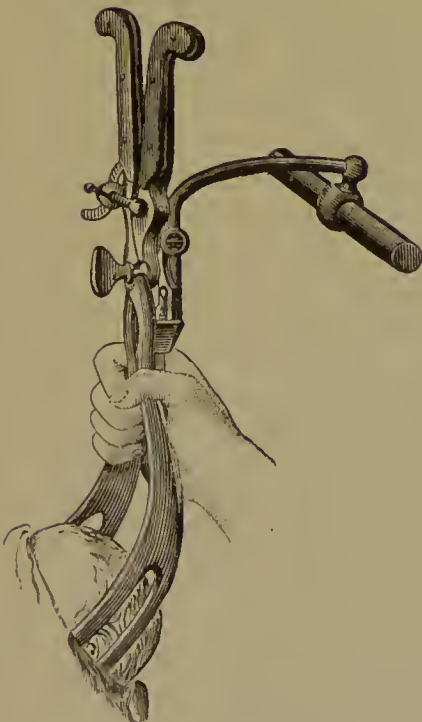
Poulet's simple expedient of passing traction cords through holes made in the cephalic portion of the blades of the ordinary long forceps, or Sanger's similar device, by either of which downward and backward traction is made, with the head free to rotate, is to be commended. Lusk's modification of Tarnier's forceps is, however, the best instrument available in America for this purpose. The traction-rod is laid upon the handle, and the blades are introduced in the ordinary manner. The compressing screw is occasionally allowed to remain unused, and should be employed with caution. Traction is made with the traction-rods until the head reaches the floor of the

FIG. 36.



Traction with Tarnier's Forceps.

FIG. 37.



Delivery by Tarnier's Forceps at the Perineum.

pelvis, when the traction rods are grasped with the handles and both are raised in guarding the perineum.

Tarnier's instrument has been extensively used in France and America, and, as modified by Simpson, in England. Its merits have found recognition in Germany, and at a recent meeting of the German Gynecological Society, Bumm and Säger expressed their decided preference for this forceps.¹ While downward traction is effected by the rods, the handles afford an index of the position of the head, and should be allowed to rotate freely as the head advances. Tarnier has abandoned the perineal curve, which Lusk retains.

In the cases under consideration, in which the head and birth-canal are proportionate in size, there is no occasion for the use of the forceps

¹ *Münchener med. Wochenschrift*, No. 25, 1888.

as a lever, or directly as a rotator, or as a compressor, further than in securing a firm grasp. The proportionate size of the head and birth-canal having been ascertained, the primary function of the forceps, traction, is all which is desired in supplementing, in a conservative manner, the expulsive forces of the mother.

THE FORCEPS WHEN THE HEAD AND BIRTH-CANAL ARE DIS- PROPORTIONATE IN SIZE.

WHEN THE FŒTUS IS ABNORMALLY LARGE.—The explanation of the factors potent in determining foetal sex and development has, in common with other obstetric hypotheses, undergone recent modification. Schroeder and Balzer have found a progressive increase in the size of the head after the third birth. Schroeder observed that the head of a first-born is susceptible to much greater moulding than the heads of children born subsequently. The belief that the individual more pronounced in type and development gives his sex to the foetus is reasonable, and awaits disproof. An extensive statistical and literary review of the influences determining foetal development by La Torre¹ results in the conclusion that the degree of foetal development depends largely upon the health of the father: if he be healthy, the size of his head and shoulders and his stature decide the corresponding peculiarities of the foetus. The weight, stature, and health of the mother exercise a comparatively slight influence upon the foetus. The supposed increase in size of the products of successive conceptions has not been observed, and the foetus of the primipara is as large as any which she bears in subsequent labors. It is easy to understand, on this assumption, the case of a fully-developed foetus borne by a deficiently-developed mother. In cases of repeated pregnancy, with a history of a normal first labor, it will often be found that the father of the first child was, like the mother, inferior in type and development, while the subsequent conceptions occurred by a second husband whose development and type are normal. If summoned to attend one of the later labors of such a patient, the obstetrician can obviously base no prognosis on the history of the first labor, because the conditions of the second are essentially different. If these cases are seen sufficiently early, the induction of labor, as now practised under antiseptic precautions, is indicated at the eighth month, and offers a very favorable prognosis for the mother. Thus, Strauch reports 28 induced labors by the introduction of a bougie under strict antisepsis, with a maternal mortality of nil.² Wyder reports 306 cases of induced labor by similar methods with mortality 3.96 per cent.³ The foetal mortality attending induced labor,

¹ *Nouvelles Archives d'Obstétrique et de Gynécologie*, Nos. 6, 7, 8, and 9, 1888.

² *Archiv für Gynäkologie*, Band xxxi. Heft 3.

³ *Ibid.*, Band xxxii. Heft 1.

which Strauch estimates at 55 per cent., should lead the obstetrician to give the mother and her friends the choice of this procedure or Cæsarean section. The latter operation would be done in such a case upon what Gustav Braun has exemplified as the relative indication.¹ The proposal to apply forceps to a head of greater proportionate size than the maternal pelvis, although the latter be symmetrical or normal, is based upon the supposition that such compression can be made by the instrument as to reduce essentially the diameters of the foetal head, either symmetrically or in a manner known to the operator and under his control. The practical fallacy of this hypothesis was early shown by Pétrequin,² Delore,³ and Budin,⁴ whose experiments show that compression of the head in one diameter is followed by an increase in another diameter. Fehling⁵ and Keller⁶ have observed that compression of the head equably upon all sides results in a symmetrical diminution in volume, caused by the recession of blood and cerebro-spinal fluid. This may be taken as a physiological compression, which is undoubtedly present in normal labor. It affords no proof, however, that a large head can be so lessened in its diameter by forceps that it will engage in a pelvis proportionately much smaller.

Recent experiments upon the effect of compression of the foetal skull, by Murray,⁷ illustrate the results of very moderate pressure in the occipito-frontal diameter. Compensation results in these cases by the sliding of the occipital and frontal bones under the ends of the parietal bones, with vertical elongation of the skull: the transverse diameters are not enlarged by moderate pressure. Axis traction with moderate pressure, when the head had engaged transversely, would bring the axis of elongation into the pelvic axis, enabling delivery to proceed and imitating the natural phenomena of labor.

Compression made in excess of this physiological phenomenon can result only in distorting the head, injuring the brain, and wounding the maternal tissues. It is evident that the hydrocephalic head should not be grasped by forceps, because the danger that the blades will slip is very great, and rupture of the uterus has resulted from such an accident. The hydrocephalic head should be punctured by a fine trocar, and sufficient fluid removed to allow labor to terminate spontaneously, or, preferably, to enable the obstetrician to perform version.

WHEN THE FŒTUS IS ABNORMALLY SMALL.—The application of the forceps to a head inferior in size to the birth-canal is rarely indicated. The great majority of obstetricians, of all nations, agree in preferring version in this condition. Should the os but partially dilate,

¹ *Wiener Medizinische Presse*, No. 9, 1888.

² *Traité d'Anatomie topographique*.

³ *Gazette hebdom.*, 1865.

⁴ *De la Tête du Fœtus au Point de Vue de l'Obstétrique*.

⁵ *Arch. für Gynäkol.*, Band vi. p. 68.

⁶ *Dissertation*, Erlangen, 1877.

⁷ *Edinburgh Med. Journ.*, Nov., 1888, p. 417.

and ineffectual labor-pains threaten the exhaustion of the patient, it may possibly be admissible to introduce narrow-bladed forceps within the uterus, dilate the os with the head, and deliver the child.¹ But spontaneous delivery, with speedy labor, is the rule when the fœtus is abnormally small, and version is indicated when interference is justified.

FORCEPS IN CONTRACTED PELVES.

Recent studies in the anatomy of the birth-canal, the perfecting of the Cæsarean operation, and antiseptics have altered very materially the beliefs of obstetricians regarding the indications for the use of the forceps in contracted pelves. But little more than ten years ago Tarnier's forceps had not been invented; the anatomical division of the uterus into expulsive and elastic segments had not been made; Sönger's operation was unknown; and antiseptics were not understood and were irrationally used. Each of these data is an important factor in determining the means to be employed in effecting delivery through a contracted pelvis.²

The growth of knowledge regarding these cases has limited the forceps to its original function—a tractor and a conservative instrument for mother and child. In well-appointed maternities the obstetrician will become aware of disproportion in the size of the pelvis before labor, if the patient remains for some time in the wards, from the routine examination of pregnant women by pelvimetry and palpation and auscultation. He may then induce labor, and thus secure more favorable conditions for delivery than would otherwise obtain. Should he be called to a patient having a contracted pelvis and already in labor, the history of a previous labor may give him a valuable clue. If the patient be a primipara, it becomes necessary to ascertain the form of pelvic disproportion present, the comparative size of the fœtus, and to consider any anatomical peculiarities which the patient may have as a primipara which are factors in choosing a mode of treatment. The form of pelvic disproportion may be determined by external pelvimetry, by internal measurements if the head has not

¹ The writer once had occasion to apply forceps to the head of an undersized fœtus at the pelvic brim in a woman markedly syphilitic, in whose cervix syphilitic cicatricial tissue prevented dilatation. By the exercise of the greatest caution mother and child were uninjured. The blades grasped the head over the face and occiput, but normal rotation occurred during delivery by intermittent tractions.

² An interesting discussion on version *vs.* forceps in contracted pelves, between Goodell and Elwood Wilson, is found in *Trans. Phil. Obstet. Soc.*, May, 1875. Goodell championed version, quoting extensively from modern obstetricians, while Wilson advanced arguments for the supremacy of the forceps. The discussion illustrates the progress of obstetric science and the opposition which partisans of the forceps have made to other modes of treatment.

engaged in such a manner as to make the sacral promontory inaccessible, and by the position of the child's head if it has engaged.

In flat, non-rhachitic pelves the head will often be found with its occipito-frontal diameter in the transverse diameter of the pelvis, while the parietal eminences occupy different pelvic planes. In symmetrically contracted pelves, should the head engage, the vertex will descend, the occipito-frontal or suboccipito-bregmatic diameter occupying an oblique pelvic diameter or possibly the conjugate. But each contracted pelvis is peculiar in its configuration, and hence the variation in the position of the head and its degree of moulding in these cases. Should the pelvic disproportion be very great, the head will be found above the pelvic brim, often in an iliac fossa. The comparative or proportionate size of the head can best be determined by the procedure of Müller¹ and Hofmeier, pressing the head downward into the pelvic canal by force applied above the pubes. If the head has begun to descend, the possibility of its further progress may be estimated by locating with the examining finger the spines of the ischia; if the head with its greatest biparietal diameter has passed a line drawn between the spines of the ischia, it can emerge from the pelvis.²

The consideration of the difference in structure between the expulsive or muscular and the elastic segments of the uterus readily explains the different conditions which obtain in primiparæ and multiparæ the subjects of pelvic contraction. Not only is the uterine muscle of the primipara more firm than that of the multipara, but the inferior or elastic segment of the uterus is much stronger and capable of far more resistance and elastic force in the woman in her first labor than subsequently. The obstetrician will therefore expect that the primipara will be able to exercise sufficient expulsive force to cause the head to engage in a contracted pelvis of minor grade, when in the multipara over-distension of the elastic segment and failure to engage will result. Remembering the cardinal function of the forceps, that of traction, he will naturally be justified in supplementing the expulsive forces of a primipara, in whom the head has engaged and moulded, by axis traction, provided no obstacle to delivery exists at the pelvic outlet. With multiparæ the conditions are more often favorable to version by reason of the greater elasticity of the lower uterine segment and the inferior expulsive force of the uterine and abdominal muscles. It has been shown by numerous obstetric writers that the head accommodates itself best to the pelvic canal when not in the embrace of a rigid instrument like the forceps. If the natural forces have not accomplished the first step in delivery—namely, moulding and engagement of the head—version is to be favorably considered.

Numerical measurements are commonly quoted as furnishing indica-

¹ *Samml. klin. Vorträge*, Leipzig, 1885, No. 264.

² Professor Spaeth, Vienna.

tions for a choice between forceps, version, craniotomy, and Cesarean section. Experience has shown that the selection of a mode of delivery rests upon too many factors to enable the obstetrician to base his choice upon a certain number of inches in a given pelvic diameter. A careful estimate of the proportionate size of mother and child, of the mechanical obstacles to be overcome, and the mechanical power at hand to accomplish this end will furnish rational grounds for a choice of procedures: this choice should be based very largely upon the history of former labors if they have occurred. If a woman has once been delivered of a living child, a second child of the same father can probably be born alive: bearing in mind the anatomical and physiological differences between primiparæ and multiparæ, a woman with a moderately contracted pelvis may partially deliver herself in a first labor completed by forceps, while subsequent pregnancies may be terminated by the induction of labor or version with safety to mother and child.

Certain general rules may be stated as aiding in determining the treatment of these cases. In flattened pelvis forceps should not be employed at the brim. The head engaging in the transverse diameter of the pelvis, the application of the forceps would be to the face and occiput, resulting in compression of the head and increase in the biparietal diameter already engaged. Rotation and accommodation would be retarded by this procedure; the maternal tissues would be in danger of injury from the ill-applied blades, while the child's life would be jeopardized by pressure upon the neck. If the head has not firmly engaged, version is indicated; if engagement has occurred, descent should be awaited, when, if needed, the forceps may be applied in the pelvic canal or at its floor, and delivery effected after methods ordinarily employed. In symmetrically-contracted pelvis of moderate contraction, the child being of medium size, and engagement having occurred, axis traction is indicated, the mother's expulsive forces failing. If engagement has not occurred and efforts to favor it fail, version is preferable. In cases of great disproportion between the birth-canal and fœtus the forceps are contraindicated, and their use can result in disaster only.

Regarding the pelvic dimensions which justify forceps, Carl Braun, writing before the improvement in Cesarean section, allows *tentative* traction with forceps when the antero-posterior diameter of the pelvic inlet measures 3.12 inches, the head engages and moulds, the caput succedaneum increases, and the mother's expulsive forces fail: if the head does not readily descend, traction must cease.¹ Pinard expresses the views of the French by limiting tentative traction to the same measurement, with the same precautions. But these opinions are based upon the state of obstetric science before the modern data already stated were available as a basis of judgment.

¹ *Lehrbuch der Geburtshülfe.*

It may, therefore, at the present day be held that, while 3.12 inches is the shortest antero-posterior pelvic diameter justifying a cautious attempt at forceps delivery *when the head has engaged*, with this measurement, should the child be large and the head not engage, Cæsarean section should be kept in mind; forceps should be used with extreme caution as a tentative instrument only, and the mother should be given the election of Cæsarean section before her tissues have become bruised and œdematous. If the head has not engaged and begun to descend, the forceps must not be applied. The well-known views of Schroeder on this point may be here referred to—opinions which have greatly influenced usage among German obstetricians. An antero-posterior diameter of 3.7 inches generally permits delivery spontaneously; for a lesser measurement he deprecates the forceps, even in tentative tractions, advises version, and, when the conditions are not favorable for version, Cæsarean section or craniotomy. While exceptionally skilful forceps-operators have contested Schroeder's views, it cannot be doubted that they furnish a safe limit for the application of forceps in contracted pelves. Data suitable for the guidance of obstetricians of average skill are most valuable in forming current opinion and improving obstetric practice.

FORCEPS TO THE AFTER-COMING HEAD.

The application of the forceps to the head in breech deliveries has been warmly commended and as warmly condemned. In cases where the size of the pelvis and the head are proportionate there are better methods of completing delivery. When unusual rigidity of the pelvic floor and external genitalia is present the forceps may be indicated to overcome this rigidity with sufficient rapidity to save the child's life. When the pelvic outlet is deformed or malposition of the head exists, the forceps is often an efficient means of extracting the head, but with laceration of the cervix or perineum. The forceps, in head-last deliveries, is a lesser evil, only to be invoked to avoid a positive danger to the child's life. When the abdomen of the child is turned to the mother's abdomen and the chin presents anteriorly, the trunk should be raised and the forceps applied beneath the child's back; the occiput will rotate posteriorly, and is to be brought over the pelvic floor by the forceps. With the occiput anterior, the back of the child to the mother's abdominal surface, the forceps may be applied beneath its abdomen; the chin will rotate to the pelvic floor, and is to be flexed over the perineum by the forceps. The blades should be applied to the sides of the head, and as completely as possible, to avoid danger to the maternal tissues from their projecting tips. Although the cases in which the use of the forceps in breech labors is required are very

infrequent,¹ the instrument should be at hand, properly cleaned and immersed in a warm solution of 5 per cent. carbolic acid in these cases. Axis-traction forceps are preferable in cases where delay is not entirely dependent upon the rigidity or stenosis of the vulva, but results from failure of rotation.²

THE FORCEPS TO THE SEVERED HEAD.

It occasionally happens that after decapitation the head remains engaged at the pelvic brim. Should an effort to grasp it with forceps be determined upon, the head must be brought to engage, if possible, by suprapubic pressure; it must at least be firmly held until the blades are properly adjusted. If necessary, the hand may be inserted in the uterus and the blades guided in this manner.

THE SECONDARY AND EXCEPTIONAL FUNCTIONS OF THE FORCEPS.

Although the forceps is recognized as primarily a tractor, occasions arise in which its secondary and exceptional functions are called into consideration. The propriety of using the instrument as a compressor, rotator, lever, and protector of the perineum has been the subject of frequent and earnest discussion. As more exact knowledge of the anatomy of the parts involved and of the physiology of the process of parturition has become current, together with increased safety in manipulation, these secondary functions of the forceps have been more and more completely subordinated to the natural mechanism of labor. As has been stated, compression of the head by forceps beyond the point of securing a firm grasp results in frustrating nature's efforts to accommodate the head to the pelvis and in injury to the child. As a rotator the forceps is inferior to the agents which normally produce rotation, and as an instrument it is not to be preferred to the aseptic hand. As a lever Galabin³ has shown that the forceps must be considered as forming a single bar, not included in the divisions made of levers nor conforming to mechanical laws. The fulcrum results from power being exerted downward and slightly to one side. Pendulum tractions are superfluous in ordinary cases of inertia of the expulsive forces, and it is difficult to recognize their utility in complicated cases. That they can

¹ See a recent discussion in the German Society for Gynecology in which twenty-one methods of delivering the after-coming head were mentioned (*Münchener medizinische Wochenschrift*, No. 22, 1888).

² Credé (*Archiv für Gynäkologie*, Band xxv. Heft 2, 1885) reports 16 cases of forceps to the after-coming head—8 in normal, 8 in slightly-contracted pelves. His results were, maternal mortality 1, fetal mortality 4. Credé advises forceps in these cases when the antero-posterior diameter of the inlet is 3.5 inches.

³ *Obstetrical Journal*, November, 1876.

do great harm has been exemplified. Traction with forceps should be uniformly gradual and intermittent, of moderate force, with very limited compression, and in the axis of the birth-canal.

There remains, however, the function of the forceps as a preserver of the perineum, in which its conservative character as an instrument is well illustrated. In precipitate labors, where from excessive irritability of the nervous system the mother's expulsive forces cannot be controlled, the forceps applied to the head at the pelvic floor may be used successfully to preserve flexion by lowering the handles, governing the descent of the head, and the dilatation of the vulva and the tension of the perineum. The instrument is especially useful in those cases where anaesthetics are not admissible. The emergence of the head is not hastened, but delayed by this application of the forceps; and it is held by Duer and other American obstetricians of wide experience that in precipitate labor the perineum may thus be efficiently protected. This is not a procedure for those unskilful and inexperienced in the use of forceps, but for experienced and accomplished operators.

THE MORBIDITY AND MORTALITY OF FORCEPS APPLICATIONS.

To the Mother.—With proper antiseptic precautions the maternal morbidity from the use of forceps is inconsiderable. If the maternal tissues, swollen by the pressure occurring in delayed labor, are not infected by the operator or instrument, the increased risk of disease to the mother is very slight when the instrument is applied to the head at the pelvic floor. The risk increases with the presence of variations from occipito-anterior positions, which give increased frequency of mechanical injury. Tumefaction and soreness of the vulva and vagina are the mildest of the affections caused by forceps. Should septic infection occur, the case may be limited to lymphangitis of the vagina and cervix, without infection of the endometrium or constitutional implication. In rare cases the simplest forceps delivery, without laceration of the perineum, may be followed by septicæmia and death. While laceration of the perineum offers greater risk of infection, immediate suture under antiseptic precautions renders this complication of less importance than formerly. In difficult forceps deliveries the vaginal fornices may be torn, the septa between the bladder and rectum and vagina perforated, the cervix lacerated, and the perineum ruptured, rarely into the bowel. Such injuries are unwarrantable and very exceptional, and the most difficult delivery should not necessitate a greater injury than superficial lacerations of cervix and vagina and moderately ruptured perineum, which generally heal promptly under antiseptic precautions.

The maternal mortality from forceps, aside from these severe and unwarrantable injuries, results from septic infection. It is found,

naturally enough, that in proportion as antiseptic precautions are enforced and judgment is shown in using the instrument, the mortality becomes almost *nil*, as is the case in the best maternities at present. The improper use of forceps in deformed pelvis is most fatal, the death-rate among mothers having been 30 to 40 per cent. When, however, the forceps is used intelligently in contracted pelvis, the mortality compares favorably with that of the other methods of treatment for this condition. Thus, Winter¹ reports 98 cases of forceps deliveries occurring in 632 cases of contracted pelvis, with a maternal morbidity of 8 per cent. and a mortality of *nil*. These deliveries were made with a full understanding of the modern data already referred to, and with the aid of proper antisepsis: they exhibit the results of the discriminate use of the instrument. The indiscriminate use of forceps in contracted pelvis results, as stated, in a maternal mortality-rate of 40 per cent.²

In forceps deliveries when the child and birth-canal are proportionate in size, the maternal mortality-rate is that exhibited in the best maternities from sepsis—0.72 to 0.42 per cent.³

To the Child.—The subject of injuries to the fœtus by forceps has been less perfectly studied than other points regarding the use of the instrument, and invites investigation. Fissures in the fœtal scalp, depression of the bones of the skull, occasional fracture and compression of the brain, and rupture of cerebral vessels, have all been noted. Lomer in 27 cases of fracture of the skull by forceps found the lesion most frequently in the frontal bone; in 6 cases the sagittal suture was ruptured, and in 4 the lambdoid.⁴ Among the milder injuries following forceps delivery paralysis of the facial nerve is most frequent. This was early described by Landouzy,⁵ and subsequently studied by Parrot and Troissier,⁶ who found the change in the nerve in severe cases to be a fatty degeneration resembling that which follows section of a nerve-trunk. Ordinarily, the affection is mild, and disappears spontaneously in a short time. In 86 cases of axis traction Bumm reports 8 cases of facial paralysis and wounds of the integument; 9 children were asphyxiated, 6 severely.⁷

Regarding the influence of compression exercised upon the fœtal head by the pelvis or the forceps in the production of paralysis, recent investigations have added to our previous knowledge. Gowers⁸ describes cerebral palsies as following difficult labor, generally accompanied by extravasation of blood upon the surface of the brain, ending

¹ *Zeitschrift für Geburtshülfe*, Band xiii. 1886.

² Hugenberger and Williams.

³ Fischel: *Centralblatt f. Gynäkologie*, Nos. 32 and 33, 1888.

⁴ *Zeitschrift für Geburtshülfe und Gyn.*, Band x. p. 334.

⁵ *Gazette méd. de Paris*, 1839.

⁶ *Archives de Tocologie*, 1876.

⁷ *Sammlung klin. Vorträge*, Leipzig, No. 318, 1888.

⁸ *Lancet*, April 14–21, 1888.

in death or tedious recovery. Osler,¹ in reviewing the literature of the subject, has found that cerebral palsy in children is not commonly recognized as caused by forceps; he adds nine cases which he has personally observed of children delivered with forceps and palsied. That defective and retarded cerebral development may follow undue compression of the head by forceps, and paresis and paralysis, is more than probable. Any depression in the cranium of a newborn child must not be ascribed to violence at birth, for Osiander and Carl Brann describe fissures of considerable depth following easy delivery. Fortunately, of very rare occurrence are those cases of terrible injury to the cranium and scalp in which a forceps blade pierces the scalp and crushes the bone.

Sloughing of the scalp from compression is more often seen, and may result independently of fracture. Parvin² has collected instructive cases of sloughing of the foetal scalp, occurring after instrumental labor, and exceptionally after spontaneous delivery.

The mortality among children delivered with forceps where the pelvis and the foetus are proportionate in size is slight. Indeed, it may be questioned whether the forceps properly used is not an effective agent in lessening foetal as well as maternal mortality. In marked contrast to this conservative influence upon foetal life is the result of the injudicious use of forceps in contracted pelves. Hugenberger and Williams report 70 per cent. and 60 per cent. foetal mortality respectively from this cause. That a fatal issue to the foetus is not a necessary result of birth in contracted pelves is shown by Winter,³ who reports but 15 per cent. foetal mortality among primiparæ and 13 per cent. in multiparæ where this complication existed and the use of forceps was practised with reference to the anatomical and physiological conditions present in each patient. Poppel has estimated foetal mortality from forceps at 10.8 per cent., and Spiegelberg at 17 per cent.

In common with the results obtained with mothers, it may be concluded that when rationally employed the forceps does not increase foetal mortality, but is a truly conservative instrument. When irrationally used, it is capable of doing great damage. Regarding the morbidity following its use, Osler⁴ found, in reviewing the literature of cerebral palsies in children, no statement directly charging the instrument with this result. With this the recent observations of Lovett agree,⁵ who in 60 cases of cerebral paralysis in children could trace no connection with forceps delivery. It remains to be determined whether causes affecting foetal life *in utero* are not the more potent factors producing such lesions, and not the forceps. There exist, however, a

¹ *Medical News*, July 14, 1888.

² *Ibid.*, November 12, 1887, p. 562.

³ *Op. cit.*

⁴ *Op. cit.*

⁵ *Boston Med. and Surg. Journal*, 1888, pp. 118, 641.

sufficient number of cases of injury from this source to render caution in using forceps an imperative duty.

ACCIDENTS ACCOMPANYING FORCEPS DELIVERIES.

The most frequent mishaps in the use of forceps not to be directly imputed to the operator's carelessness are the slipping of the instrument and separation of the symphysis pubis. If care be taken to apply the blades to the head, and as perfectly as possible, the forceps will rarely leave the head: a slight change in position will often occur, especially when forceps are applied to the sides of the pelvis. In consulting practice more than a single instrument is usually available, and should one slip with tentative traction, a second whose cephalic curve is better adapted to the configuration of the head should be selected. A decided failure in apposition of the blades should result in their withdrawal and reapplication.¹

Separation of the pubic symphysis may occur after forcible traction, and also with the exercise of but moderate force. Thus, Faux reports² a case in which crepitus was perceived during axis traction with Tarnier's forceps in a primipara aged twenty-five, the position being right occipito-posterior, although but moderate force was exerted. The diagnosis was confirmed after labor; uninterrupted recovery followed. The reader is also referred to cases reported and discussion by Dührssen, Olshausen, Veit, Martin, and Gusserow.³ Cases of traction which straightened the blades of the forceps, or in which the blades left the head with great suddenness, or in which the tractile force of several individuals was combined, cannot be regarded illustrations of the skillful use of the instrument: failure to make axis traction or the choice of an inferior instrument is generally the fault in these occurrences.

THE FREQUENCY OF FORCEPS APPLICATIONS.

An estimate of the frequency with which the forceps is used in private practice is not readily obtained. Patients sufficiently well-to-do to be confined at home are often inferior in muscular development to hospital patients, who come more frequently from classes engaged in manual labor. Among the former failure of expulsion through muscular exhaustion is not infrequent, and hence the forceps is often used. The statistics of private practice are rarely available, and the usage of the best maternities may be taken as furnishing an approximate esti-

¹ Cleeman (*Trans. Phil. Obst. Society*, 1877-78, vol. v.) has added a pelvic curve to the shank of the forceps, to prevent slipping.

² *Bulletin de la Société obstétricale de Paris*, No. 8, 1888.

³ *Centralblatt für Gynäkologie*, No. 49, 1888, p. 813.

mate of good practice in private. Forceps applications to save the time and convenience of the operator are not included in this category. Pinard¹ estimates that before the invention of axis-traction forceps 11 European operators applied the forceps 113 times in 117,000 births. Tarnier, in the twenty-nine years preceding his invention, in 55,000 births at the Maternité used forceps once in 97 labors in normal pelvises, once in 275 births in contracted pelvises. Early statistics of the Rotunda Hospital at Dublin give 1 application in 700 births. The improvement of the instrument and its more skilful use have led to its more frequent application in appropriate cases, while increased knowledge of the normal mechanism of labor has limited its unnecessary employment. In proportion as version is favored in contracted pelvises the forceps is not used, and where pelvimetry is practised induced labor, version, and craniotomy lessen the number of forceps operations. In Spaeth's clinic in Vienna, in 2761 births in 1885, the forceps was used 77 times—once in 35+ labors. In the Rotunda at Dublin,² during three years ending 1886, 203 forceps applications occurred in 3414 births—1 in 16. At the Royal Maternity of Edinburgh the average use was 1 in 10.6 for one quarter of a year.³ This proportion included 1 case with axis-traction forceps to each 88 births, while in the Simpson Memorial Hospital 1 in every 7.2 labors was completed by axis-traction forceps.⁴ These recent statistics agree with the earlier estimate of Churchill to the effect that forceps are used twice as often in England as on the Continent. Going to the other extreme of modern obstetric practice, we find Ahlfeld reporting but 3 forceps deliveries in 308 labors—1 in 102.⁵ He has, however, revived an ancient procedure, that of placing the woman on a birth-stool to facilitate the descent of the foetus.

The frequency of forceps deliveries in American maternities may be said to occupy a position between the statistics quoted. In the Philadelphia Hospital,⁶ during 1887, the forceps was used once in 27 labors, and the rules of the institution are such that the instrument is not hastily resorted to. In 112 deliveries at the Boston Lying-in Hospital forceps were used 7 times, = 1 in 16 labors.⁷ It is probable that forceps cases are more common in private practice than in maternities, where the discipline of an institution forbids their use without a positive indication.

THE VECTIS.—The secret instrument sold by Hugh Chamberlen to Roonhuysen, and made public in 1753 by De Vischer and Von der Poll, was most probably the vectis. By some the invention of the vectis is ascribed to Roonhuysen, but this is denied by others. The

¹ *Dict. Encyclop. des Sciences médicales, loc. cit.*

² *Dublin Journ. Med. Sciences*, 1887, p. 472.

³ *Edinburgh Med. Journ.*, Sept., 1888. ⁴ *Ibid.*, Oct., 1888.

⁵ *Deutsche med. Wochenschrift*, Nos. 23-28, 1888.

⁶ *Annual Report Dept. Charities and Corrections*, 1887.

⁷ *Boston Med. and Surg. Journ.*, Aug. 30, 1888.

instrument became most popular in England, where it attained equal rank with the forceps. At the present day it is a favorite with but few obstetricians, and, in spite of occasional attempts to popularize its use, it is now, in America at least, a curiosity. The original instrument is said to have been a curved plate of steel; in its most approved form it is practically the blade of a short straight forceps, often inserted in a wooden handle. The handle has been occasionally hinged for greater convenience of carriage. Among American obstetricians Hodge advocated its use to perfect flexion and aid rotation. Modern Continental obstetricians consider the vectis a superfluity and not to be commended. Fabbri of Bologna has employed it successfully, and Goodell has found his method of advantage, and describes it as follows:¹ "In those transverse cranial positions at the brim due to a contraction in the conjugate diameter, whenever the blades cannot be applied to the sides or to the fronto-mastoid diameter of the head, the following method will be found of signal advantage—of far greater, in fact, than the application of the forceps over the face and occiput: The tractor passed over the pubic side of the mastoid region is at first used as a lever of the first kind, the left hand on the shank representing the fulcrum, and the right hand becoming the power by raising the handle toward the pubes; in other words, each hand acts in opposite directions, the left one mainly to protect the pubes from pressure. As soon as the hand is raised high enough for the blade to secure a good purchase, and also to compress the offending transverse diameter of the head, then traction is thus made: The right hand is kept at rest to become the fulcrum of a lever of the third kind, while the left acts as the power. This compound action of traction and leverage meets here several important indications. It compresses the head in its lateral diameter, flexes it, and forces its pubic side to revolve around the promontory of the sacrum as the centre of motion, to slide over the smooth surface of the pubic symphysis, and to roll over into the pelvic cavity."

In comparison with the forceps the vectis is better available as a lever, as the hand readily furnishes a fulcrum, and the handle is better adapted for this purpose than the forceps handles. Its safety as a lever

FIG. 38.



The Vectis.

lies in the fact that the fulcrum is not made by the maternal tissues, but by the hand. In the hands of an expert it may occasionally render valuable service, but the desuetude into which it has fallen is a

¹ *American Practitioner*, January, 1873.

striking proof that rotators and levers other than those furnished by nature are rarely useful, and for practical purposes are superfluous.

The vectis represented in the accompanying illustration is that commonly used in England, and has a hinged handle.

EMBRYOTOMY.

Among the oldest of obstetric operations is that for lessening the size of the foetal head. The Father of Medicine invented a curved knife for opening the cranium and an instrument for crushing the bones. Celsus and Soranus practised opening the head with a knife and extracting fragments of bone with bone-forceps, while the Arabians possessed a complete armamentarium of instruments for the destruction of the foetus. The temporary loss of the operation of version during the Middle Ages increased the frequency of destructive operations, until Ambrose Paré, in 1550, restored version to its deservedly important place among obstetric resources.

The destructive operations have been at times abused, and again neglected. Thus, Osiander the elder boasted that in forty years' practice he had never done craniotomy, while, with the irony of fate, his son performed the operation in his father's clinic in Göttingen while the elder lay dying. Playfair writes that at one period in the history of English obstetric science the forceps was supplanted by craniotomy at the Dublin Rotunda Hospital, 21,867 births having occurred without a single employment of the conservative instrument; at another time craniotomy was done three or four times as frequently as forceps delivery. It is probable that at present the improvement in Cæsarean section is inaugurating a period of comparative neglect for the destructive operations; in fact, the belief is expressed that destruction of the living foetus has ceased to be justifiable, and that the non-viable foetus only shall be subjected to partial destruction. While this may be questioned, views formerly accepted regarding the destructive operations must be essentially modified, and a complete reversal of many obstetric dicta seems the duty of the hour.

From the standpoint of ethics the destruction of the living child has always been regarded with horror. Common law was early invoked to decide whose right is paramount in these cases—that of mother or child. Following the dictum of Cicero, that life is to be preserved which is of most value to the state and society, and that life is the mother's. This principle has been repeatedly recognized in affairs of state, as illustrated by Napoleon I. But the sacrifice of the foetus in these cases is based upon the premise that embryotomy is less dangerous to the mother than Cæsarean section. While it may not be asserted at present that the Cæsarean section offers invariably as good a chance of recovery to the

mother as embryotomy, yet her chance for life and health under the former is so vastly improved with the modern operation that this ancient premise is greatly weakened, and the obstetrician is called to make his decision and to advise his patient on grounds which have existed but a short time and which mark the growth of obstetric science. The proportions of the dead fœtus may be altered at the judgment of the operator in the mother's interest without hesitation; and in this regard the destructive operations are sometimes neglected, it being not infrequently safer to perform craniotomy upon a dead fœtus than to deliver the head by forceps before its size is lessened.

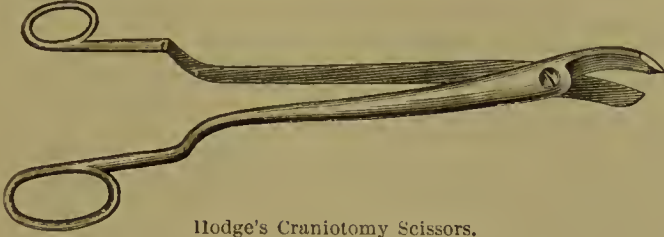
THE INDICATION FOR PERFORMING AN OPERATION DESTRUCTIVE TO THE FŒTUS.—In general, disproportion between the size of the fœtus and the pelvis or birth-canal is the indication for materially lessening the fœtal proportions. The pelvic measurements which may be relied upon as absolute indications have been questioned, and the many factors which enter into a decision regarding the choice of a mode of treatment in serious complications of labor render in this instance the choice of embryotomy a matter of comparative judgment, and not an arbitrary selection.

Such disproportion may result from abnormally advanced ossification and development of the skull—from hydrocephalus or from the presence of a fœtal monstrosity. On the side of the mother contraction of the pelvis is the most frequent indication: abnormal rigidity or deformity of the pelvic floor may require the lessening of the fœtal proportions. An abnormal relation of the fœtal diameters and those of the pelvis may indicate embryotomy, as when the chin of a fœtus normal in size rotates into the hollow of the sacrum in a normal pelvis; a neglected shoulder presentation with impaction may call for embryotomy. The relative indications for the destructive operations will be discussed when the recent statistics of these and more conservative procedures are considered.

CRANIOTOMY AND EMBRYOTOMY.—As the head most frequently presents, and furnishes the greatest obstacle to birth, so it is the portion of the fœtus most often to be reduced in size. Craniotomy, lessening materially the diameters of the fœtal head, is the most frequently performed of the destructive operations. Embryotomy may be applied in general to all destructive operations: in distinction from craniotomy, the various procedures for severing the trunk or evacuating one of the trunk-cavities have received names descriptive of each particular operation. The manner in which the diameters of the head are lessened has introduced descriptive terms into the nomenclature of craniotomy. Thus, *cranioclasm* and *cephalotripsy* describe not only the piercing of the head, but crushing its parts; this is exemplified in *basiotripsy*, breaking up the base of the skull. Again, the nomencla-

ture of instruments has added technical terms to those descriptive of the operation only. Embryotomy may be considered, however, an appropriate term for any operation destructive to the fœtus, and craniotomy

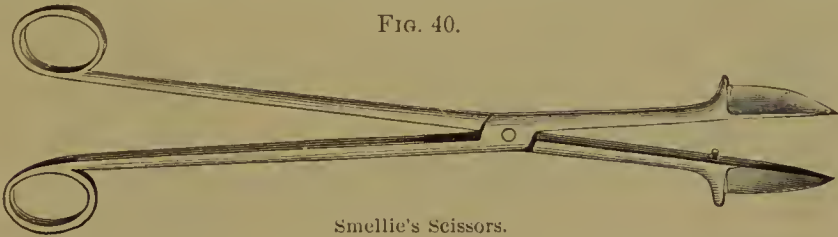
FIG. 39.



Hodge's Craniotomy Scissors.

may be conveniently used as indicating the destructive operation most frequently performed, describing as it does the seat of the operation.

FIG. 40.



Smellie's Scissors.

CRANIOTOMY.—The diameters of the fœtal head are most often lessened by perforating the skull and evacuating a portion of its contents. Perforators vary in simplicity from scissors to a trephine espe-

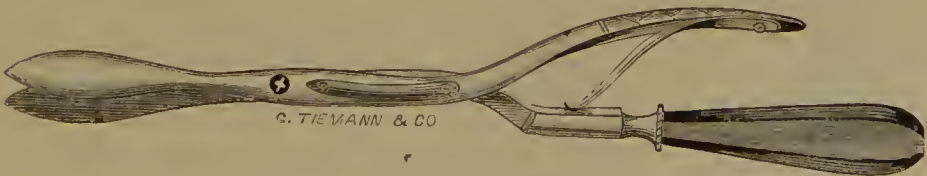
FIG. 41.



Naegele's Perforator.

cially constructed for this purpose. Hodge's craniotomy scissors and Smellie's scissors are familiar types of the simplest perforator. More

FIG. 42.



Blot's Perforator.

complicated but convenient instruments are Naegele's perforator and the spear-pointed instrument of Blot.

Among German obstetricians a trephine is the favorite perforator, and the models of Braun and Martin are most often used.

A simple scissor-like instrument has the advantages of being manipulated with but a single hand of the operator and of being easily cleaned: its disadvantages are that the aperture made by it is often closed by the pressure to which the head is subjected, and thus the purpose of the operation is defeated. Then the evacuation of the brain is not so readily accomplished. The trephine perforator, by removing a disk of bone, makes a permanent opening in the cranium through which an irrigating tube may be passed and the brain thoroughly removed by a forcible douche of antiseptic fluid. The most recent models of trephines are composed of three simple parts, which can be taken asunder and thoroughly cleansed.

FIG. 43.

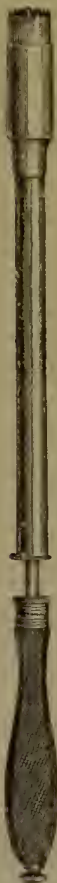


FIG. 44.

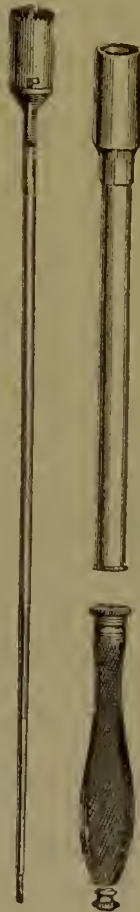


FIG. 45.



Martin's Trephine.
Parts Together. Taken Asunder.

Braun's Curved Trephine.

In using the simple scissor-like perforators it will often be convenient to pierce a suture or fontanelle, and if the disproportion in the size of the head is not excessive, the long-continued pressure of labor

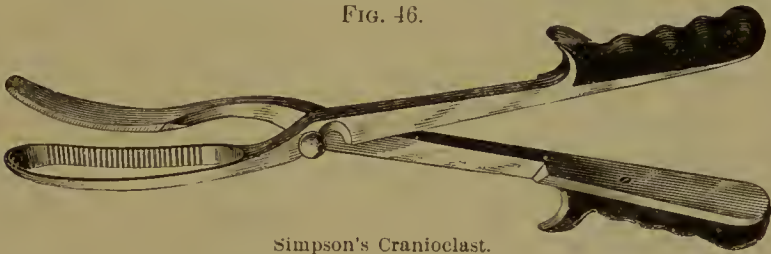
will evacuate sufficient of the cranial contents to allow birth to take place. In performing craniotomy with the trephine the cranial opening should not be in a suture or fontanelle, but through the unbroken cranial wall.

Martin's trephine (Figs. 43, 44) is simple in its construction and readily cleansed: it is straight. Carl Braun's curved trephine is more complex and less easily cleansed and disinfected.

Simple perforation of the skull and the evacuation of a portion of its contents rarely suffice to lessen the diameters of the head sufficiently to admit of spontaneous delivery. The base of the cranium commonly offers the greatest obstacle to the birth of the head, and hence its size must be lessened. This is accomplished by the pelvic walls when traction is made upon the perforated and partially emptied head, or by an instrument selected for the purpose.

If perforation be performed and traction and counter-pressure from the pelvis be chosen, the use of the cranioclast should follow the per-

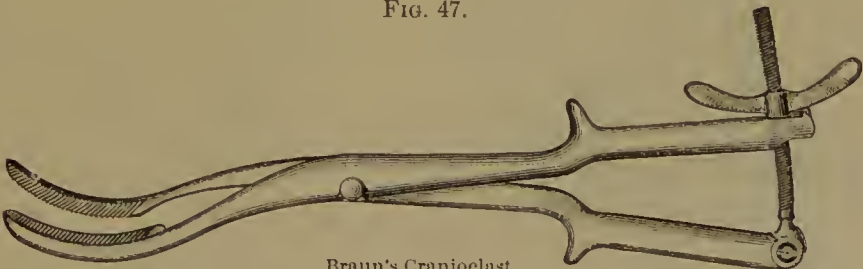
FIG. 46.



Simpson's Cranioclast.

foration. This instrument is virtually a strong prehensile forceps, one blade of which is passed within the cranium, while the other grasps the wall of the skull from without. The cranioclasts most used are Simpson's and Brann's. The former was intended to combine a crushing instrument with a traction forceps. The larger blade, heavily grooved, is to be applied without the cranium, while the smaller, pos-

FIG. 47.



Braun's Cranioclast.

sessing ridges which fit the grooves of the first, is inserted within the skull. The lock is a button joint, and the compressing power must be directly exercised by the operator. By rotary movements of the blades various portions of the skull may be grasped and broken, and the weight

and strength of the instrument are provided for this purpose. As a tractor it is most effective; as a crushing instrument it is excelled by the cephalotribe. The original Simpson model lacked a pelvic curve.

Braun's cranioclast, lighter in weight than Simpson's, is designed for traction only. The construction and mode of application of its blades resemble, in their cephalic portion, Simpson's instrument: the grasping power is exercised by a compressing screw at the extremities of the handles. It possesses the button lock and a pelvic curve. Braun's cranioclast fulfils the purpose for which it was designed most admirably.

When the operator wishes to break up the skull at the time of perforation, a cephalotribe is to be preferred. This instrument is the

FIG. 49.



Blot's Cephalotribe.

FIG. 48.



Hicks' Cephalotribe.

invention of Baudelocque (the nephew), and was given to the profession in 1829, with the hope and expectation that it would supersede the perforator. This hope has not been realized, and while the cephalotribe is a valuable supplement to the perforator in very firmly ossified and large heads, yet in the majority of cases it is inferior to the cranioclast as a

means of delivery. Various non-fenestrated forceps¹ with a compressing screw have been used as cephalotribes. Principally in use are the instruments of Hicks, Blot, and Breisky, and in America the model of Lusk. The two former (Figs. 48, 49) are narrow strong forceps, with non-fenestrated blades, and compressing screw at the extremities of the

handles: the instrument of Hicks has no pelvic curve. The instruments of Breisky and Lusk (Figs. 50, 51) are heavy forceps with cephalic and pelvic curves; in Lusk's cephalotribe the inner aspect of the blades is deeply grooved.

The original instrument of Baudelocque was large and very heavy, and

FIG. 50.



Breisky's Cephalotribe.

FIG. 51.



Lusk's Cephalotribe.

was soon modified, as the opinion gained ground that perforation should first be done and then the cephalotribe applied. When the cranioclast proves inefficient to deliver the head after perforation, the

¹ For the recent advocacy of this instrument see J. Price, *Medical News*, Aug. 12, 1885, p. 219.

cephalotribe may be employed if the pelvic contraction be not extreme. As some of the same objections exist to compression of the head by the cephalotribe which were stated regarding a similar use of the forceps, the cephalotribe should be limited to moderately contracted pelvises. The models most resembling forceps, with a pelvic curve, are largely used.

It not infrequently happens that the direct application of force to the base of the cranium is necessary. For this purpose the basilyst of Simpson¹ and the powerful basiotribe of Tarnier have been devised. The former consists of a rod terminating in a bulb-shaped serew: the rod and its serew tip are split longitudinally, and the halves can be separated with considerable force by a device at the handle. After perforation the instrument is passed through the opening in the skull to

FIG. 52.



Simpson's Basilyst.

the base of the cranium, in which its serew tip is inserted by a boring motion: when well engaged the halves are separated, and the fractured bone thus dislocated. The soft parts of the head ordinarily guard the tip from injuring the mother, as it is not necessary that the instrument project from the skull.²

The most complete invention for crushing the fetal head, including the base, is the basiotribe of Tarnier.³ This instrument consists of a central blade terminating at its cephalic extremity in a serew tip; this blade bears a button similar to that which the Naegele forceps possesses, and at its external extremity is shaped to afford a firm grasp. A longer and a shorter blade, shaped like the cephalotribe forceps, are joined like forceps blades, the central serew occupying the space in the concavity of their cephalic extremities. A compressing serew at the extremities of the cephalotribe blades completes the instrument. It is applied by perforating the cranium with the central bar by boring through the vault: the cephalotribe blades are then applied, and the base of the cranium broken up by crushing. As the head is secured by the perforator, the compression results in applying force directly to the base.

For the extraction of the head after perforation, or to remove portions of the skull after evacuation of its contents, craniotomies and crani-

¹ *Edinburgh Med. Journal*, 1882 and 1883, pp. 769-778.

² J. Price (*loc. cit.*) has recently advocated a forceps perforator, the point of which is guarded by a leather shield, while the other blade carries a serew perforator for piercing the spinal canal.

³ Bar: *Le Progrès médical*, Nos. 51 and 52, 1884.

otomy forceps may be employed. The former have been the objects of much reproach, but in skilful hands have served a useful purpose when the better instruments were not available. The latter are simply the

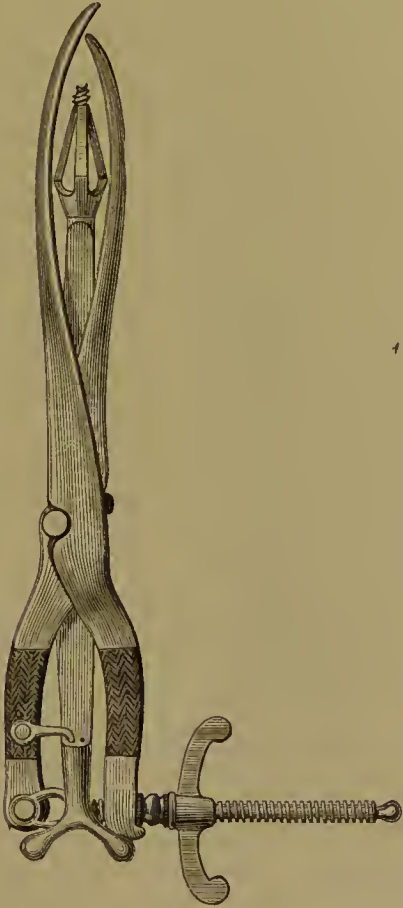
blunt-edged bone-forceps of the surgeon, and may be straight or curved, as are his sequestrum or duckbill forceps.

A most useful addition to the resources of the obstetrician who performs craniotomy is suitable apparatus for thoroughly evacuating the skull. For this purpose a firm canula and a strong piston syringe are requisite. The tube should be of considerable lumen: a full-sized catheter is the smallest tube which can be used to advantage. Better than this is Carl Braun's hard-rubber curved tube or a tube of block tin slightly curved, with perforations on each side of the tip of size sufficient to permit the passage of a full stream of fluid. It is also desirable that the canula be sufficiently strong to be used to break up brain tissue and tear the meninges. The syringe may be of metal, or preferably of hard rubber, to be used with solutions of bichloride of mercury. As the tube is introduced within the opening made by the perforator, the impetus of

the fluid injected is confined within the skull, and hence no danger of the entrance of fluid or air into the uterine sinuses is caused by the injection.

THE OPERATION OF CRANIOTOMY IN HEAD PRESENTATIONS.—When craniotomy has been determined upon, there are certain considerations, aside from the scientific aspect of the case, which pertain to the relations of the obstetrician to his patient and her friends. A considerable proportion of the religious world holds views regarding the destiny of the soul that perishes without the rites of the Church which render the destruction of the living fœtus a peculiarly momentous occurrence. Should the fœtus be living, the obstetrician will do well to give the patient and her family the fullest opportunity to secure the ministra-

FIG. 53.



Tarnier's Basiotribe.

tions of the faith which they hold. He should not bear the responsibility of destroying the living fœtus without professional support when

FIG. 54.



Application of Tarnier's Basiotribe.

FIG. 55.



Basiotripsy Accomplished.

it can be obtained. In view of the present status of Cæsarean section the mother and her friends should be fully cognizant of the proposed operation, and should the fœtus be living they should be allowed to

FIG. 56.



Crotchets.

choose, after careful explanation, between the destruction of the fœtus and Cæsarean section.

Before proceeding to craniotomy the rectum and bladder should be

emptied and precautions taken to secure strict antisepsis. The instruments to be used should be washed with soap and warm water and

FIG. 57.

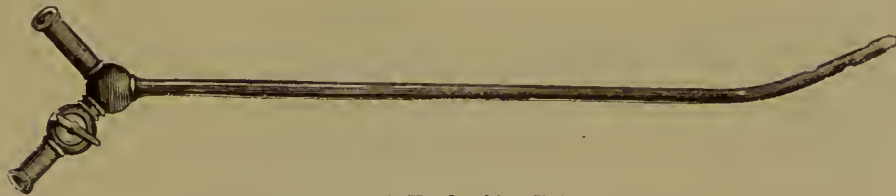


Craniotomy Forceps.

immersed in a 5 per cent. solution of carbolic acid. The external genitalia of the patient should be thoroughly washed with soap and water and a solution of bichloride of mercury 1 : 2000. She should be placed with her buttocks projecting over the edge of a bed or table, the limbs supported in chairs or held by assistants. A copious vaginal douche (not less than two quarts) of bichloride solution, 1 : 5000, moderately heated, should be given. The operator, having rendered his hands and arms aseptic, should sit before his patient, having his instruments within reach, and also a gallon of the mercuric solution, 1 : 5000, warmed. A bucket or pail which may be covered at once should be at hand to receive the fœtus. It will be best, in the majority of cases, to anæsthetize the patient, to spare her physical and mental suffering. An assistant should stand beside her to hold the fœtus firmly in position by suprapubic pressure.

Having carefully determined the position of the head, if the operator use a scissor perforator the left hand should be inserted in the vagina and the perforator guided to a suitable point for piercing the cranium.

FIG. 58.



Braun's Hard-rubber Tube.

If it is deemed sufficient to pierce a suture or fontanelle and allow the expulsive forces of nature to partially empty the head and deliver it,

FIG. 59.



Hard-rubber Syringe.

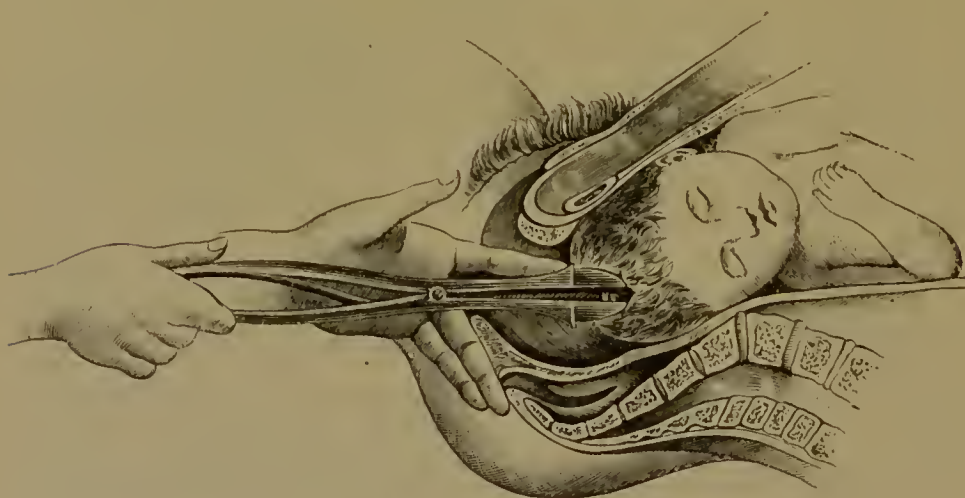
the perforator may be introduced in this manner, being partially withdrawn, turned at right angles to its first insertion, reinserted, and the aperture enlarged. It is best, however, having entered the head, to

break up the medulla oblongata and the brain, either with the perforator or the canula. The cranium should then be thoroughly evacuated by the injection of bichloride solution, 1 : 5000, with force sufficient to wash out the brain. If the simple perforator has been used, the escape of cerebral tissue will be less prompt and complete than when the trephine is employed.

In exceptional cases the head is left after perforation and evacuation to be normally delivered. This can be a justifiable procedure only when the woman has been so short a time in labor that her tissues are uninjured and when the foetus is not macerated. It is, in the vast majority of cases, best to complete delivery after perforation and evacuation.

Whenever its application is possible the trephine is to be preferred for craniotomy. It makes a permanent opening through which cerebral tissue is freely evacuated, and readily permits the application of the cranioclast. To use the trephine great care must be exercised to hold it firmly against the cranium, and if the operator's grasp be not fully competent for this, an assistant should press the trephine firmly against

FIG. 60.



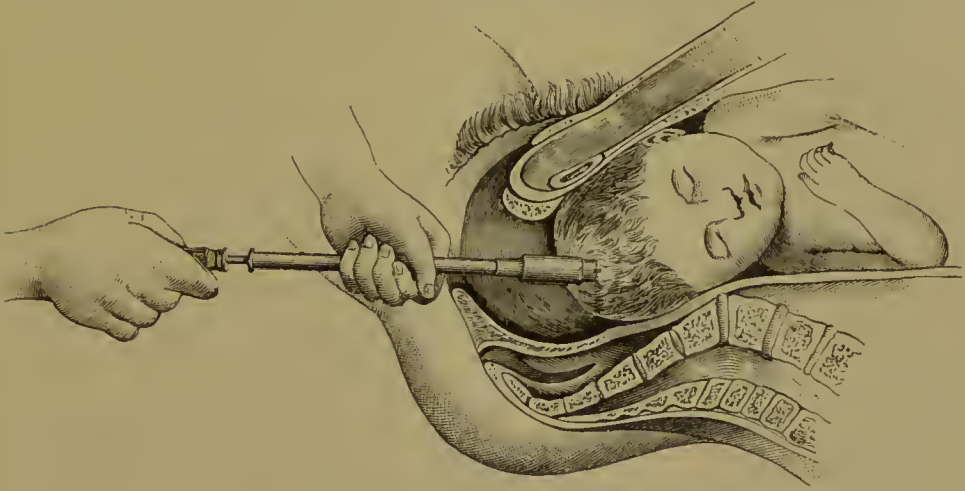
The Use of the Simple Perforator.

the bone under the guidance of the operator's left hand, while with his right the crown of the trephine is rotated. A point should be chosen in bony tissue for trephining, and the operator will usually find a parietal bone or the occipital accessible. The cranium having been opened, the brain should be thoroughly broken up by pushing the trephine into the cerebral mass, or by any convenient instrument. The canula should then be passed to the base of the skull, and the warmed solution of bichloride of mercury, 1 : 5000, should be injected. The canula should be moved about until it is felt that the brain is thoroughly

disorganized. The injection of fluid should be continued as long as the return current brings fragments of tissue with it.

Unless the base of the cranium is unusually large and firm, delivery should be completed by the cranioclast. The size of the blades of this instrument is adapted for its introduction through the opening made by the trephine. The left blade of the cranioclast, which, like the left blade of the forceps, contains the button of the lock, is passed first through the trephine aperture. This blade bears the solid, roughened

FIG. 61.



Craniotomy with Martin's Trephine.

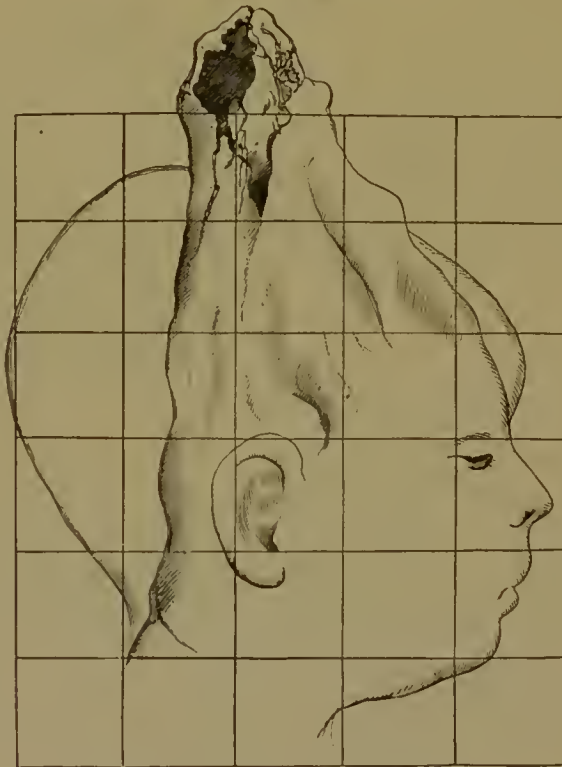
cephalic portion which fits into a corresponding aperture in the right blade. The right blade is passed without the skull to receive the left blade covered by the soft parts in its grasp. By the compressing screw a firm hold is secured, and traction in the axis of the pelvis, in the manner in which the forceps is used, will complete delivery. The head ordinarily emerges flattened antero-posteriorly into an irregular cone.

Among the advantages to which the cranioclast of Braun can lay claim are its small size; the fact that its blades are nearly covered by soft parts during extraction, as one is within the head and the other is buried in the scalp; the security of its grip, which can be varied if needed; its simplicity, which allows it to be readily cleaned; and its pelvic curve, which permits rotation of the evacuated head and advantageous traction. Experience has shown that during traction with Braun's cranioclast the head moulds itself by the pressure of the pelvic walls without injury to the maternal tissues, as the only point at which the cranium is pierced is turned toward the aperture of the birth-canal, and is continually under the direction of the operator. The left blade should be passed deeply to the base of the cranium, while the right should grasp that opposite surface of the head which lies lowest in the pelvic axis.

After the delivery of the child and placenta an intra-uterine douche of hot thymol, 1 : 1000, or of bichloride of mercury, 1 : 5000, should be given. A uterine suppository containing from 30 to 60 grains of iodoform should be placed within the internal os. Any lacerations of the perineum should be carefully closed, superficial lesions of the vagina dusted with iodoform, and the regular administration of small doses of ergot, 15 to 30 drops of fluid extract every six hours, will often be found useful in favoring uterine involution.

Strict antisepsis is imperative in performing craniotomy, and if faithfully carried out the patient's convalescence is often speedy and uncom-

FIG. 62.



The Head after Delivery by the Cranioclast.

licated. No further vaginal douches are needed, unless a positive indication, as foul lochia with fever, arises. Should the mother be very anæmic or there be reason to suspect the existence of nephritis, the intra-uterine and vaginal douches should not be of a mercurial solution, but of carbolic acid or thymol.

It may happen that the base of the cranium will not yield to the counter-pressure of the pelvic walls without the risk of injury to the maternal tissues. The use of the cephalotribe (cephalotripsy) is then indicated. This instrument is to be applied as is the forceps. Care must be taken that spiculæ of bone do not project at the aperture made

by perforation to wound the maternal tissues. Especial caution should be exercised to apply the blades accurately to the head: enough of the hand should be inserted in the vagina, or a finger may be placed in the skull, to determine bony landmarks positively. The left hand should constantly ascertain and guide the position of the head during extraction. As in the use of the forceps, rotation of the head into its most favorable relation with the pelvis is best obtained by traction in the axis of the pelvis, the cranium elongating itself in the long axis of the cephalic portion of the blade of the instrument by the escape of its contents and the overlapping of the edges of the punctured bone at the point of perforation.

The cephalotribe is a more dangerous instrument to the mother than the cranioclast: with the instrument of Tarnier remarkably good results are reported by the French, to which reference will be made later. Perforation by the trephine, thorough evacuation of the cranium, and delivery by the cranioclast after Braun's method, as described, offer the least dangers to the mother in the larger proportion of craniotomies.

IN EXCEPTIONAL PRESENTATIONS OF THE HEAD.—In face presentations Auvard¹ advises perforating the forehead, and inserting one blade of the cranioclast in this aperture, the other in the mouth. Tarnier's simple basiotribe may be used as a trephine in these cases. When a suitable bony surface for trephining is not available, the simple perforator may be employed (Blot's, Naegele's). When bony landmarks cannot be recognized, perforation may be made at any convenient point. It is essential in these cases that the perforation be very deep; if through an orbit or the palatine region, the cavity of the cranium must be fairly opened, followed by thorough evacuation.

CRANIOTOMY ON THE AFTER-COMING HEAD.—Craniotomy is not indicated upon the after-coming head of the living child. An obstacle to delivery which cannot be overcome without craniotomy will soon cause the death of the fetus. The operation is more difficult than in head presentations, because of the position of the head and the fact that the best localities for trephining are inaccessible. The trephine can very rarely be used in these cases, and the point of the perforator is liable to slip from the oblique direction at which it meets the head. The occipito-atlantoid ligament and the lateral fontanelles have been recommended as affording easy entrance to the perforator; but when the emergency arises no one anatomical landmark is selected, but the cranium is pierced as is most convenient under the existing circumstances. If the occiput be behind the pubes, the body may be raised and perforation made through the mouth or orbit. If the chin is anterior, the trunk may be held by an assistant and the base of the cranium entered. When the head is transverse in the pelvis, the

¹ *Thèse*, Paris, 1884.

trunk may be raised or lowered strongly and the region of the ear perforated.

The cephalotribe is occasionally used to extract the after-coming head without perforation. The head is favorably situated for the exercise of the crushing force of the instrument upon the base, and Lusk has found that the head accommodates itself readily to the pelvis. The traction made during delivery in breech presentations generally suffices to deliver the perforated head without difficulty: it sometimes happens that forceps modelled after the French instruments, which make strong compression, are found useful after the head has been perforated.

VERSION AND FORCEPS AFTER CRANIOTOMY.—Version after perforation has been strongly urged. If the head is emptied early in labor, and spiculae of bone do not project from the aperture made by the perforator, version may be a safe and advantageous procedure. It is obviously not to be considered in delayed cases where uterine retraction has occurred and the inferior segment of the uterus is greatly distended. In the greater number of cases extraction with the cranioclast will be found a safer and less difficult procedure than version after craniotomy.

The application of the forceps to the perforated head is attended with decided risk. Accurate and firm apposition of the blades is rarely possible, as the form and size of the head change under the pressure of the instrument. The blades are very likely to slip unless the instrument be one capable of making very decided compression. As stated, it is occasionally advantageous to aid the delivery of the after-coming head with forceps when it is not readily delivered after craniotomy; but forceps should not be applied in head presentations when the cranium has been opened.

RESECTION OF THE HEAD.—Great ingenuity has been exercised in devising instruments for resecting the fetal head in such a manner as to mechanically remove the resistance offered by the base of the cranium. Von Huevil and Tarnier have designed complicated forceps-saws by which a wedge whose larger end lies at the vertex, and whose narrow surface extends through the base, is removed. Barnes resects the head successfully with the wire *écraseur*. The Lollini in Bologna, Guyon, and Hubert have invented instruments for piercing the base and resecting the head. In the hands of their inventors these appliances have rendered good service, but they are rarely accessible to the average operator, who would not readily comprehend their use.

RESECTION OF THE FÆTAL TRUNK.—In contracted pelves when the fetus has become impacted, in neglected shoulder presentations, and in monstrosities it may become necessary to resect the trunk of the fetus. Decapitation is the most commonly performed of these resec-

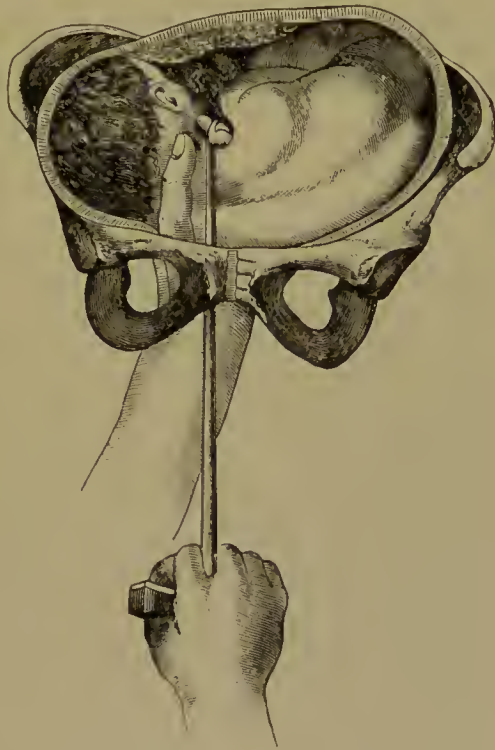
tions. For this purpose the decapitation hook of Carl Braun is often employed. It consists of a rod tapering to the hook, which forms an acute angle with the rod and is tipped by a slight enlargement. The handle, at right angles to the rod, is sufficiently large to afford a firm grasp. To perform decapitation with Braun's hook the fingers of one hand should encircle the neck, while the hook should be guided to grasp the neck just below the fingers of the hand inserted. Down-

FIG. 63.



Carl Braun's Decapitation Hook.

FIG. 64.



Decapitation by the Hook.

ward tractions with rotary motions will rapidly sever the attachment of the head to the body. As the spinal column is felt to yield caution should be exercised, lest the hook leave its position suddenly and injure the maternal tissues.

Blunt-pointed scissors may often be used to advantage in completing the division of the fasciæ and skin.

The chain saw has been passed around the neck by various devices: Tarnier and Thomas have devised complicated instruments for resecting the trunk by this means. A strong cord may be used, a catheter and stylet serving as guides in application. The use of a speculum is necessary in these cases to prevent injury to the vagina by the cutting of the cord. Pajot has fastened a lead ball to a strong cord and passed

it about the neck by the blunt-hook commonly used in France: the weight of the ball brings the cord to the operator's grasp. Doléris¹ succeeded in decapitating a dead fœtus with ease by using a cord in the method devised by Pajot.

The head is commonly severed from the trunk by obstetricians not possessing instruments especially constructed for the purpose by bringing the neck as low as possible by traction upon the prolapsed part: the left hand is then used as a guide, and strong, blunt-pointed scissors are used. The employment of the cord and speculum is a rapid and easy method when the cord can be passed. Bram's decapitation hook performs its work with an ease and rapidity which are sometimes surprising. Resection of the fœtal trunk at some point other than the neck may be accomplished by strong scissors: it is usually combined with the evacuation of one of the cavities of the trunk or evisceration. The purpose of this procedure is to fold the body upon itself and permit version or spontaneous evolution of impacted shoulder presentations. Blunt-pointed scissors or the perforator may be employed to open the cavity entered; projecting bone should then be carefully removed, and the cranioclast or blunt-hook may complete delivery. When the position of the fœtus permits it, and it is macerated, destruction and removal of the macerated viscera, if decomposition be advanced, may be advantageously accomplished by the injecting apparatus used in craniotomy, an antiseptic solution of decided strength being employed. A single thorough intra-uterine antiseptic douche and an iodoform suppository should be employed after the extraction of the fœtus.

Various complicated instruments have been invented for performing embryotomy, but their use has generally been limited to their inventors. The surgical principle that the simplest instrument is the best is very clearly applicable to these as well as to other obstetric instruments.

THE INDICATIONS FOR AND LIMITATIONS OF EMBRYOTOMY AT PRESENT.

In rightly defining the position of embryotomy as an obstetric operation at present, the matter must be viewed as impartially as possible. Sentiment, so often a hindrance to clear thinking, should be disregarded. The effort to brand a procedure as murderous which has received the practical approval of many of the most intelligent obstetricians of the time is certainly an error. On the other hand, a misconception of the powers of nature, and a practical ignorance of those precautions which render the minor obstetric operations safe to mother and child, which have led some too early to resort to embryotomy, are an equally serious error. There remains, however, a middle ground of judgment, based

¹ *Annales de Gynécologie*, March, 1885.

on the study of the anatomy and pathology of the parturient uterus, and embracing a consideration of modern operations, which enables the obstetrician to meet more intelligently than formerly the responsibilities which complicated labor entails upon him. The discussion of the propriety of embryotomy may be simplified by considering first the performance of embryotomy upon the dead fœtus, and second upon the living fœtus: the existence or non-existence of pelvic disproportion will be considered under each division of the subject.

EMBRYOTOMY UPON THE DEAD FŒTUS.—The obstetrician is not infrequently summoned to cases of delayed labor in which the fœtus has perished. Examination of the patient may reveal a pelvis normal in proportions; the fœtus in head presentation; the amniotic fluid escaped; and the uterus in a condition of contraction and retraction known as uterine tetanus.¹ The dangers which threaten are rupture of the uterus, septic infection, and exhaustion. The lower uterine segment is greatly distended by the presenting part; the superior segment is firmly retracted, and has ceased to exercise an expellent force; and pressure upon the uterine tissues is causing stasis, engorgement, and a condition inviting infection. The indication is prompt emptying of the uterus with the least danger to the mother.

The first procedure which suggests itself to the mind of the attendant is the application of forceps. If the forceps were capable of lessening the size of the fœtal head sufficiently to relieve essentially the pressure upon the uterine tissues, its use would not be an added source of danger. But we fail to find satisfactory evidence that the forceps lessens symmetrically the size of the fœtal head beyond a slight degree: the reduction of one diameter to any considerable extent is followed by an increase in another, and the danger to the over-distended uterine tissues would remain the same. The forcible extraction of the head through the over-distended lower uterine segment and cervix would add to the dangers for the mother already existing. In primiparæ, in whom the strength of the lower uterine segment is greater than in multiparæ, the danger of extracting the head before reducing its size would be less than in multiparæ; in either, extraction without reduction of size is dangerous. Version is even more dangerous when uterine tetanus is fully established. As the child has perished, there is no sufficient reason why the size of the head should not be reduced and labor speedily terminated. In the greater number of cases perforation, evacuation, and extraction with the cranioclast furnish the safest method of delivery. Should excessive rigidity of the head at the base exist, the basilyst, basiotribe, or cephalotribe may be employed.

Under strict antiseptic precautions the rate of mortality from craniotomy in these cases is very low. Traction by the cranioclast is made in

¹ Schroeder: *Lehrbuch der Geburtshülfe*.

the axis of the pelvis; if the trephine is used, no projecting spiculæ of bone endanger the maternal tissues; the thorough evacuation of the head allows it to mould readily to the pelvis, and the use of antiseptics reduces the danger of infection to a minimum. Merkel,¹ in 100 craniotomies, performed 6 when the pelvis was normal in proportions and the child had died. Thorn² in 80 craniotomies performed 14 in normal pelvis when the fœtus presented by the head or breech and had died, with a mortality of *nil*: in these cases no deformity of the fœtus existed, but disproportion between the size of the fœtus and pelvis was in some cases present. In private practice the natural repugnance to any procedure which resects the fœtus would at first result in objection to the performance of craniotomy in these cases; but if it be understood that the fœtus is dead and that the mother's life is in danger, this objection will be commonly withdrawn. The mother should invariably be anæsthetized. Where uterine tetanus exists, chloroform is preferred by Continental obstetricians, because it favors relaxation of the rigid uterine tissue. The skilful administration of chloroform in these cases has repeatedly proved advantageous, and is to be commended for more extensive use by American obstetricians. If strict antisepsis be observed at the operation, complications during the puerperal period will be reduced to a minimum.

In neglected shoulder presentations in normal pelvis, when the child is dead and a tetanic condition of the uterine muscle has supervened, embryotomy is indicated. The choice of the mode of decapitation will be decided by the resources and training of the operator: resection of the trunk, other than decapitation, may be performed as circumstances will best permit. The diameters of the after-coming head of the dead fœtus may require reduction in normal pelvis; the cephalotribe has been found especially efficacious for this purpose, for reasons which will be stated presently.

In contracted pelvis, after the death of the fœtus, the indications for embryotomy are more universally recognized. If the degree of pelvic contracture be slight and the head presents, compression by the cephalotribe may effect delivery, with traction in the axis of the pelvis, without difficulty. The necessity for perforation may occasionally be obviated by the use of the cephalotribe in these cases, as has been advised by Lusk. Notwithstanding the fact that, as a rule, a considerable degree of compression upon the fœtal skull in one diameter is followed by an increase in the size of another, the cephalotribe, when applied in the antero-posterior diameter of the head, is capable of lessening slightly that diameter with but a slight increase in one of the others. Murray³

¹ *Archiv für Gynäkologie*, Band xxi. p. 461.

² *Ibid.*, Band xxiv. Heft 3, 1884.

³ *Edinburgh Medical Journal*, November, 1888.

has found by experiment that the foetal skull is compressible in an antero-posterior direction by the sliding of the occipital and frontal bones under the ends of the parietal bones: such compression produces no appreciable enlargement in the transverse diameters; compensation is effected by vertical elongation of the skull, which provides for the accommodation of the cranial contents. Application of the compressing instrument in any but the antero-posterior diameter of the head is, however, followed by corresponding elongation of the opposite free diameter. In cases of slight pelvic contraction it may therefore be advantageous to apply the cephalotribe in the antero-posterior diameter of the head, elongate the head vertically, and deliver it by traction in the axis of the pelvis: as the foetus is dead, no thought need be given to the effect produced upon its brain by compression of the head. In slightly-contracted pelves the use of the cephalotribe upon the after-coming head, when applied in the manner recommended by Lusk and Murray, is an expedient well worthy to be kept in mind.

In contracted pelves the death of the foetus ordinarily occurs earlier in labor than in normal pelves, because of the failure of the presenting part to descend and vigorous compression of the foetus early in labor before the expulsive segment of the uterus has become exhausted. In a case of slightly contracted pelvis seen immediately after the death of the foetus, and before a tetanic condition of the uterine muscle and great distension of the inferior segment had supervened, less complete reduction of the diameters of the head would be necessary than in a case in which the pelvis was normal and the lower uterine segment was distended almost to the point of rupture. As a rule, perforation, evacuation, and delivery by the cranioclast in head presentations is safest in these cases, in normal and contracted pelves: occasionally, before uterine tetanus has developed with over-distension of the inferior segment, the use of the cephalotribe without perforation is permissible.

In markedly contracted pelves, when the foetus is dead, embryotomy is indicated. Should the conditions present have endured so long that necrosis of maternal tissues and maceration of the foetus, with tissue disorganization, exist, with beginning septicæmia, the extirpation of foetus and uterus by supravaginal amputation is to be advised. The presence of multiple fibromata complicating parturition greatly increases the danger of septicæmia from necrosis of the uterine tissues, and renders the prognosis after Cæsarean section extraordinarily grave if the uterine incision passes through a fibroid, as necrosis of the tumor follows. In multiple fibromata with death of the foetus, if symptoms of extensive tissue-necrosis be present, extirpation and drainage are indicated.¹ Embryotomy under such circumstances would result in lacer-

¹ See cases of fibromata complicating pregnancy and parturition, reported by Porak, *Bulletin de la Société Obstétricale*, No. 4, 1888; also Cæsarean section, death from sepsis

ating tissues already disorganized, and causing fresh absorption of septic virus.

EMBRYOTOMY UPON FŒTAL MONSTROSITIES.—In the case of fœtal monstrosities the mother's interests are so manifestly paramount that the propriety of performing embryotomy cannot be questioned when Nature's efforts fail in delivery. As the presentations of monsters are anomalous, no rule can be given for the performance of the operation save that of expediency, circumstances deciding the particular procedure to be adopted. Craniotomy in hydrocephalus is best performed with a trocar and canula, as the evacuation of a portion of the fluid within the skull is not necessarily fatal to the fœtus, and often permits labor to terminate normally. Schroeder's suggestion, to perform version after partially evacuating the skull, is appropriate when the conditions favorable for version exist. When version is impossible and Nature fails to deliver the head after partial evacuation, perforation, complete evacuation of the head, and delivery by the cranioclast are indicated. While the life of the hydrocephalic fœtus should not be thoughtlessly sacrificed, it cannot be held of equal value with the normal child, and its existence should not be allowed to jeopardize the mother's.

EMBRYOTOMY UPON THE LIVING FŒTUS.

Embryotomy upon the living fœtus may be considered by the obstetrician—1. When the dimensions of the pelvis are normal; 2. When the pelvis is abnormally small.

WHEN THE PELVIS IS NORMAL an abnormality in the mechanism of labor may produce conditions in which embryotomy upon the living fœtus has been advised. Such conditions are a malrotation of the head, the chin turning into the concavity of the sacrum or the occiput turning posteriorly. Failure of the head to engage and shoulder presentation persisting to the point of uterine retraction and tetanus of the uterine muscle may also suggest the performance of embryotomy. Impaction of the after-coming head and the locking of twins may raise the question of embryotomy before the death of the fœtus. An abnormal condition of the mother's soft parts may seem to indicate a destructive operation on the living fœtus: rigidity, cicatricial contraction, tumors, and congenital malformations occurring in these tissues may render the delivery of a living child through the birth-canal impossible. The destruction of an abnormally large and living fœtus has been frequently practised when no pelvic contraction existed.

IN CONTRACTED PELVES experience with the majority of obstetricians in this condition (Baily, *Lancet*, May 12, 1888), and successful Cesarean section when fibromata were present (Jay, "Cesarean Section with Oöphorectomy," *Amer. Jour. Med. Sci.*, November, 1888).

tricians has fixed 3 inches as the antero-posterior diameter through which a living child of normal proportions may pass: the French, who are especially skilled in axis traction, report the greater number of successful deliveries by forceps at or above 3 inches in the antero-posterior diameter of the inlet.¹ Regarding the antero-posterior diameter which permits the extraction of the trunk of the fœtus after embryotomy, the limits vary with the instrument employed and with the dexterity of the operator. And here, again, the French, who have given especial attention to the construction of instruments for the destructive operations, speaking from large experience, fix $2\frac{5}{8}$ inches as the limit of delivery for the fœtal body by traction after embryotomy.

But no exact measurement can be adopted as a basis of judgment, nor can fractions of an inch determine the choice of a given operation. Choice must be made upon relative size and proportions of fœtus and maternal pelvis, and a rational judgment can be formed on these grounds only.

The means at present known for ascertaining the size of the fœtal head *in utero* yield comparative information only, and consist in the attempt to fit the head into the pelvis by suprapubic pressure. Our present knowledge regarding the inferior segment of the uterus, and the importance of recognizing its over-distension in complicated labors, add an important factor in estimating the need for a radical operation whether conservative or destructive. Disproportion of fœtus and pelvis, and the condition of the mother both as regards her general strength and freedom from infection and with reference to the physiological or pathological condition of her genital tract,—these furnish to-day the basis of a rational judgment: a given pelvic measurement is useful as an indication of what has been the experience of others under similar circumstances, but is not a final ground for decision.

Granting the existence of a labor which cannot be terminated without lessening the proportions of the child to a fatal extent or injuring the mother's birth-canal in probably a fatal manner, a radical obstetric operation is demanded in the management of the case, whether the treatment be prophylactic or curative. The prophylactic treatment of this condition lies in the induction of labor. The cautious obstetrician will obtain warning of an existing abnormality in the maternal pelvis or fœtus by the history of a former labor if one has occurred: if the patient be a primipara, he should examine her from four to six weeks before her expected labor, satisfy himself of the proportionate size of fœtus and pelvis, diagnose the fœtal position and, if possible, the presentation, and be assured that no marked pelvic contraction exists. Pelvimetry may be so performed by one accustomed to examine the

¹ See the report of 29 cases by Varnier (*Gazette Hébdomadaire*, No. 47, 1888).

pelvis that the delicacy of a patient will not be offended; prudery on her part, and hesitation excusing neglect on the part of her attendant, are to be disregarded alike.

Under antiseptic treatment and modern methods of nourishing premature children much greater encouragement can be held out to a mother to submit to the induction of labor than formerly. Wyder¹ has collected 306 cases of induced labor—maternal mortality of 3.9 per cent.; Strauch² reports 26 cases, with maternal mortality *nil*; Korn,³ 45 cases—maternal mortality 2.2 per cent.; Winckel, Sabarth, Hecker, Spiegelberg, Haidlen, and Fehling have collected statistics showing maternal mortality of *nil*. The foetal mortality of induced labor Strauch found to be 55 per cent. in his cases; Caruso,⁴ averaging a large number of cases, estimates it at 39 per cent., and expects an improvement in this result by improved methods.

Induced labor under antiseptic precautions offers but little danger to the mother and a very considerable risk to the child. In the case of children with sound parentage, in good homes, and under skilful treatment this risk would be greatly lessened. The results of inducing labor are sufficiently good, on the side of the mother, to demand careful consideration for this procedure as prophylactic treatment in avoiding the dangers of complicated labor. That the chances for the child are not desperate is shown by the reports of Credé and Tarnier. The former⁵ lost but 18 per cent. of 678 premature children; the latter,⁶ 30 per cent. of 151 poorly-developed premature infants.

If the time for induced labor be past, the first operation in point of antiquity and usage demanding consideration is embryotomy, and generally craniotomy. In regarding this operation favorably the life of the foetus is of course disregarded. The chance of life and subsequent health for the mother is an excellent one under modern antiseptics. Before the antiseptic era obstetricians reported a maternal mortality from craniotomy of from 38.52 per cent. (Rigand and Stanesco) to 11.8 per cent. (Müller). The mortality of craniotomy at present, by the most experienced operators, has been greatly reduced. Thus, Spiegelberg⁷ reports 58 craniotomies with 10 per cent. maternal mortality; Wyder,⁸ 215, mortality 5.6 per cent.; Merkel,⁹ 100, with 4.7 per cent. death-rate; Olshansen,¹⁰ mortality-rate, 8.7 per cent.; Winckel,¹¹ 13.3 per cent.; Rokitsansky,¹² 52 successful cases; Jaggard,¹³

¹ *Archiv für Gynäkologie*, Band xxxii. Heft 1.

² *Ibid.*, Band xxxi. Heft 3.

³ Leopold: *Der Kaiserschnitt, etc.*, Stuttgart, 1888.

⁴ *Archiv für Gynäkologie*, Band xxxiii. Heft 2.

⁵ *Ibid.*, Band xxiv. S. 128.

⁶ Reported by Auvaré, *Archives de Tocologie*, 1883, p. 577.

⁷ *Lehrbuch der Geburtshilfe*, 1882, p. 756.

⁸ *Op. cit.*

⁹ *Archiv für Gynäkologie*, Band xxi. S. 461.

¹⁰ *Ibid.*, Band xxiv. S. 438.

¹¹ *Lehrbuch der Geburtshilfe*, Leipzig, 1888, SS. 658-712.

¹² *Lehrbuch d. g. Gynäkologie*, p. 789.

¹³ *Amer. Journ. Obst.*, 1884. p. 1132.

82 cases in Carl Braun's wards, mortality 7 per cent.; Präger,¹ 71 cases, maternal mortality-rate *nil* from sepsis, 1.4 per cent. from other causes; Determann,² 239 craniotomies, mortality from 12.8 to 9.4 per cent. These operations were, in the majority of cases, perforation and evacuation, with the use of the cranioclast or cephalotribe to complete delivery.

The French operation of cephalotripsy or basiotripsy, as done with instruments of French invention, affords excellent results so far as the mother is concerned. Pinard³ has collected 49 basiotripsies by 7 operators, with maternal mortality *nil*; Bar⁴ reports 3 favorable cases; Wasseige,⁵ 35 cephalotripsies, mortality 6 per cent.; Pajot⁶ performed 8 cephalotripsies in greatly-contracted pelves, with 6 recoveries. Potocki,⁷ in 19 cases of resection of the fœtal trunk by Tarnier's embryotome, reports a mortality of 6, 1 of which was imputed to the instrument. It is evident that embryotomy under antiseptic precautions offers to the mother an excellent chance for recovery and subsequent comfortable health. Thus, Caruso⁸ averages the results of 364 craniotomies, resulting in $6\frac{6}{10}$ per cent. mortality; $93\frac{4}{10}$ of the mothers recovered.

Regarding the frequency of embryotomy, Merkel,⁹ in analyzing 100 cases, found 1 craniotomy in 56 births; this, as Crédé¹⁰ remarks, is among a poor population, living in extremely unsanitary conditions. Thorn, reporting Olshausen's cases,¹¹ estimated 1 craniotomy to $89\frac{1}{4}$ births where sanitary conditions of life had been better. Both series of cases extended over a long term of years, beginning before the introduction of antiseptics or the perfection of induced labor and pelvimetry.

A better basis for estimating the frequency of embryotomy at present is afforded by statistics of more recent periods. In the clinic in the Vienna General Hospital, now in charge of Breisky, during 1885, 2761 births occurred; 19 craniotomies and 1 decapitation were performed, or 1 destructive operation in 138 labors.¹² At Marburg, during 1887, Ahlfeld's¹³ confinements numbered 308, without a destructive operation. At the Philadelphia Hospital 188 births occurred in 1887,¹⁴ without a destructive operation; at the Boston Lying-in Hos-

¹ Leopold: *Der Kaiserschnitt, etc.*, Stuttgart, 1888.

² *Zeitschrift für Geburtshilfe und Gynäkologie*, Band xv. Heft 2.

³ *Archives de Tocologie*, August 30, 1887.

⁴ *Le Progrès médical*, Nos. 51 and 52, 1884.

⁵ *Des Operations obstetricales*, Paris, 1881.

⁶ Charpentier: *Traité pratique des Accouchements*, tome ii. p. 750.

⁷ *Thèse*, Paris, 1888.

⁸ *Op. cit.*

⁹ *Op. cit.*

¹⁰ *Archiv für Gynäkologie*, Band xxiv. Heft 3.

¹¹ *Op. cit.*

¹² For permission to publish the records of the clinic the writer is indebted to Dr. Ludwig Piscaček, first clinical assistant.

¹³ *Deutsch. med. Wochenschrift*, Nos. 23-28, 1888.

¹⁴ *Report Dept. Charities and Correction*.

pital, in 112 births during three months in 1888, 3 craniotomies were performed.¹

The tendency has been to diminish the frequency of destructive operations as knowledge has become more complete regarding conservative measures. As serious pelvic contraction is rare in American-born women, so the destructive operations are not often performed among them. Could extensive statistics of embryotomy in private practice be obtained, it would be shown to be done less frequently than in maternities. Potocki² has found that 32,938 confinements furnished 151 shoulder presentations in hospital practice, of which about one quarter became so impacted as to require resection of the foetal trunk. This happened from no fault of the staffs of the hospitals, but from the carelessness or ignorance of the midwives and physicians of towns and villages, who neglected to perform version promptly.

If the conditions for which destructive operations are most frequently performed be considered, Merkel in his 100 cases collected 46 performed for disproportion between foetus and pelvic canal occasioned by flattening of the pelvis; 36 because of symmetrically-contracted pelvis; 6 when the pelvis was normal. Thorn in 80 operations found 16 normal pelves, but disproportion between foetus and pelvis in 80 per cent. Regarding the destructive operations from the standpoint of the treatment of contracted pelvis, Winter³ has collected the results of various modes of treatment in 632 contracted pelves in which craniotomy was performed 97 times—1 in 6.5 cases. The forceps was used 98 times, while version ended labor 271 times. These results indicate that the deciding element in fixing the choice upon a destructive operation was not a pelvic contraction in itself, but disproportion between foetus and pelvis: certain grades of disproportion were safely overcome by nature, by version and forceps, while in but a small number of cases was a destructive procedure employed. A further illustration of this distinction is found in the fact that both Winter and Thorn performed one-fifth of their craniotomies upon the after-coming head.

In estimating the indications for a destructive operation the obstetrician should not lose sight of the fact that it is not a contracted pelvis which will necessitate a destructive operation, but such disproportion between the type and development of foetus and pelvis as to defeat Nature's efforts at delivery, aided by the conservative resources of the obstetric art. It is an interesting and even curious fact that as the degree of disproportion between foetus and pelvis becomes pronounced the mortality of the destructive operations is lessened. Thus, Wyder⁴

¹ Boardman: *Boston Med. and Surg. Journal*, No. 9, 1888.

² *Op. cit.*

³ *Zeitschrift für Geburtsh. und Gynäk.*, Band xxxi., 1886.

⁴ *Op. cit.*

found a maternal mortality of 15 per cent. when craniotomy was performed in pelves whose antero-posterior diameter at the inlet was $3\frac{1}{2}$ + inches; from $2\frac{3}{4}$ to $3\frac{1}{2}$ inches, 10 per cent.; from $2\frac{1}{8}$ to $2\frac{3}{4}$ inches, mortality *nil*. The explanation may be found in futile efforts at delivery with forceps by the obstetrician, resulting from failure to correctly estimate the existing disproportion between fœtus and mother and the physiological or pathological conditions present. As the disproportion became more evident the patient was spared these injurious and futile endeavors.

To summarize the discussion of the choice of embryotomy (generally craniotomy) upon the living fœtus, it may be said that the importance of a prophylactic scrutiny of the pregnant woman from four to six weeks before labor must be strongly urged: a previous successful pregnancy and parturition throws the bulk of evidence in favor of a second similar labor, provided the paternity and general conditions be the same. A practical estimate of the comparative type and development of mother and fœtus is afforded by palpation and auscultation, by the adaptation of the presenting part to the pelvic canal by suprapubic pressure and by pelvimetry. Should decided disproportion be diagnosed, the induction of labor under antiseptic precautions is attended by a minimum risk to the mother; fœtal mortality, with competent after-treatment, varies from 18 to 39 per cent. Should decided disproportion between fœtus and mother not be diagnosed or neglected, and labor occur, or should dystocia become absolute through failure in the mechanism or dynamics of parturition, the obstetrician may terminate labor by embryotomy with an average maternal mortality of 6.6 per cent. under antiseptic precautions, but with the inevitable death of the fœtus. For the discussion of the indications for the use of forceps the reader is referred to previous pages upon that subject: briefly, the engagement and moulding of the head at the superior strait of the pelvis, in a primipara of average strength and not infected by sepsis, furnishes an indication for forceps. Regarding version, the fact that the head is not excessively large or unusually ossified, as ascertained by palpation and vaginal touch; the multiparity of the mother; freedom from over-distension in the lower uterine segment, with absence of tetanus of the uterine muscle and septic infection,—are indications for this procedure.

Excluding induced labor, forceps, and version as inappropriate, there remain for comparison with the results of embryotomy those afforded by modern Cæsarean section, laparo-elytrotomy, amputation of the pregnant uterus, and symphysiotomy.

The maternal mortality of the first 50 cases of the modern Cæsarean section performed in continental Europe was estimated at from 20¹ to

¹ Harris: *The Medical News*, 1887, p. 686.

17.9¹ per cent. on the part of the mothers, and 2 per cent. of the children. The revival of the operation in the United States was followed by 11 operations, with maternal mortality $45\frac{5}{11}$ per cent., and fetal mortality $27\frac{3}{11}$ per cent.² Within a short time the list of successful cases has been increased, improving the statistics of American operations.³

The status of the operation among German operators has been described by Leopold in a recent work.⁴ The maternal mortality under the improved operation at his clinic in Dresden during the past four years has been 8.6 per cent.—4.3 per cent. from sepsis; fetal mortality was 13 per cent. These operations were performed largely for pelvic contraction. Caruso⁵ tabulates 135 cases to October 1, 1888, with maternal mortality $25\frac{5.6}{106}$ per cent., including the first 50 reported in Europe; fetal mortality, 8.27 per cent. In cases of repeated Cæsarean section the mortality was *nil*. It is interesting among the operators of all civilized nations whose results are tabulated by Carnso to notice that, after Germans, Americans have operated most frequently. When it is considered that Leopold leads German operators in the number of his Cæsarean sections, his results may be taken as a fair index of the chances of the operation under the best conditions: the results reported by Caruso are not an optimistic estimate of this procedure, but the results obtained by a miscellaneous collection of obstetricians. It is probably a fair conclusion to estimate these figures—8.6 per cent. and 25.5 per cent. mortality among mothers—as representing the range of the modern operation. Fœtal mortality varies from 13 to 8.27 per cent.⁶

The operation of gastro-elytrotomy may be regarded as an expedient, but not as a hopeful resort, in difficult labor. Clarke⁷ and McKim⁸ report 14 cases, to which Caruso adds 4, in the literature of the subject, aggregating 18. The latter very properly disregards the 4 cases in estimating the results, as the operations were performed before modern surgical methods were known; the remaining 14 give a maternal mortality of 50 per cent. and a fetal mortality of 42.8 per cent. This operation cannot be regarded as anything but a doubtful resource, to be employed only in the failure of better means of completing labor.

Symphysiotomy as practised by the Italian school of obstetrics gives

¹ Wyder: *op. cit.*

² Harris: *Medical News*, 1888, p. 350.

³ See the cases of Jaggard (*Medical News*, 1888, p. 405), Kelly, *ibid.*, Sept. 22, 1888, p. 320, and Jay (*Amer. Journ. Med. Sci.*, November, 1888, p. 465).

⁴ *Der Kaiserschnitt und Seine Stellung zur Künstlichen Frühgeburt, Wendung und Perforation bei Engem Becken*, Stuttgart, Enke, 1888.

⁵ *Archiv für Gynäkologie*, Band xxxiii. Heft 2, S. 211.

⁶ Harris (*Medical News*, Dec. 15, 1888, p. 678) has collected 149 Cæsarean operations; maternal mortality, $27\frac{1}{2}$ per cent.

⁷ *Thèse*, Nancy, 1887.

⁸ *New York Med. Journ.*, 1887, p. 651.

results comparing favorably with those of the modern Cæsarean operation. Harris' statement of 50 Neapolitan cases¹ shows a maternal mortality of 25 per cent. and foetal mortality of 18 per cent. This operation has been hitherto confined to the Italian and French schools, and has not been practised in Germany or America to any great extent. It is to be regarded as a practicable and rational means of effecting delivery in contracted pelves, but not readily available to Americans because of the lack of experience with the operation among American obstetricians. At the present time the indications for symphysiotomy are set forth by Morisani² as follows: 2.6 inches is the shortest true conjugate at which the operation is justified; the gain in the antero-posterior diameter of the pelvic inlet is .85 to .97 of an inch by the operation, which is permissible when the antero-posterior pelvic measurement is 3.12 inches and forceps and version are contraindicated.

Amputation of the pregnant uterus (Porro's or the Porro-Müller operation) is not to be regarded as a rival to the modern Cæsarean section, but as indicated in conditions which the more conservative operation cannot meet. The indications for amputation of the pregnant uterus are set forth by Leopold³ as follows: Infection of the body of the uterus; stenosis of cervix and vagina by tumors not connected with the uterus; uterine myomata; pregnancy in an occluded uterus bicornis; in ruptured uterus in contracted pelves; in retained placenta, with sepsis; in osteomalacia. Tait⁴ has recently published his method of operating in 3 successful cases, in which the technical difficulties of the operation were greatly reduced.⁵ Porro, Breisky, and others have shown that the results of this operation are such as to cause it to be regarded as a complement to the modern Cæsarean section in conditions where the removal of the body of the uterus is indicated to save the mother's life or prevent subsequent conception. For purposes of comparison with embryotomy it may be considered together with the Cæsarean section.

For the American obstetrician, when the time for prophylaxis is past, and a living foetus cannot be delivered by version or forceps, there remains practically the choice of a radically destructive or a radically conservative procedure—embryotomy or uterine section, whether so-called Cæsarean section or amputation. No subject in the range of obstetric science has occasioned keener discussion than this. With the introduction of antiseptics both operations have shown greatly improved results. The constant improvement in the

¹ *Amer. Journ. Med. Sci.*, 1883, p. 25.

² *Proceedings Italian Obstetrical and Gyn. Soc.*, Sept. 3, 1888.

³ *Op. cit.*

⁴ *British Medical Journal*, Nov. 17, 1888, p. 1100.

⁵ Harris (*Med. News*, Dec. 15, 1888, p. 678) has collected 232 Porro operations—mortality, 47 $\frac{3}{10}$ per cent.

details of surgical procedures, and Säger's vitally important modifications in closing the uterine wound and preventing hemorrhage, have brought the radically conservative procedure to a stage of efficiency where its claims cannot be disregarded.¹ The question naturally arises, Upon what grounds may the obstetrician feel personally justified in advising his patient to submit to the Cæsarean section or uterine amputation? As all medical and surgical service is rendered under a moral and legal contract by virtue of which the physician guarantees competent knowledge and skill, the degree of especial dexterity requisite for this operation is a point of interest. The researches of Harris, Caruso's collection of cases, and a study of recent successful operations lead to the belief that a theoretical and practical knowledge of the cardinal axioms of surgery as practised to-day is requisite. Thus, Hofmeier² considers the essentials of success to be scrupulous antisepsis, early operation, sufficient uterine sutures. Leopold³ holds it as essential that operator and assistant understand antisepsis and the plan of operation.

As the tendency of modern surgery is to simplicity in operating, no matter how minute the precautions for avoiding septic infection may be, so the Cæsarean operation requires few instruments and but average technical skill. Intelligent judgment regarding the time for operating, a thorough observance of antisepsis, and the co-operation of several intelligent assistants are demanded. These conditions on the part of the obstetrician are not difficult to fulfil. For the performance of embryotomy a knowledge and observance of antiseptic precautions are requisite equal to those demanded for Cæsarean section. The technical skill needed to perform a difficult embryotomy is fully as great as, if not greater than, that which the Cæsarean operation calls into play, while the instruments employed for the destructive operation are more complicated than the simple surgical appliances needed in the conservative procedure.

Inasmuch as the chances for the mother's life are not yet equally good under embryotomy and uterine section, the absolutely essential condition of the latter must be the consent of the mother or her friends. This is insisted upon by Leopold⁴ and Caruso,⁵ and has been frequently exemplified in practice. Equally important is the mother's condition. She must not be exhausted and in the beginning of labor; she must be free from septic infection and from severe injury from previous efforts at delivery. On the side of the fœtus heart-

¹ For controversial literature on this point see Montgomery, *Medical Times*, 1888, p. 387; Busey, *Amer. Journ. Obst.*, 1884, p. 178; Jaggard, *ibid.*, p. 1132; Meadows, Tait, and Barnes, *British Gynecological Journ.*, 1886-87, vol. ii. p. 308; and Lébédoff, *Archiv f. Gynäkol.*, 1887-88, Band xxxi. p. 218.

² *Zeitschrift für Geburtshilfe und Gyn.*, Band xiv. Heft 1.

³ *Op. cit.*

⁴ *Op. cit.*

⁵ *Op. cit.*

sounds must be normal in strength and frequency (Leopold). When these conditions obtain and the obstetrician feels personally justified in assuming the responsibility of an operation, the mother's chances for life and recovery may be stated as follows: With the sacrifice of her child *at least* nine chances out of ten for her own recovery; with the modern Cæsarean section her chance for life ranges from three in four to nine in ten,¹ while her infant has nine chances in ten for life.

That the outlook for the Cæsarean operation in the United States will improve there can be no doubt; at present American operators have not equalled those of Germany, who are far in advance of all others. The obstetrician cannot discharge his full duty to his patient and her unborn child in the dangerous complications of parturition which call for radical treatment without stating to her friends and to herself the conditions of that choice which modern science affords her. These conditions are of too recent origin for the popular intelligence to have apprehended them, but the obstetrician, whose duty it is to give his patients the benefit of the most recent knowledge, cannot escape the obligation which they entail upon him.

¹ Estimates of Caruso and Harris, the operation having been done under favorable conditions.

THE PREMATURE INDUCTION OF LABOR.

By JAMES C. CAMERON, M. D.,

MONTREAL.

By "the premature induction of labor" is meant the artificial arrest of gestation in the interests of the mother or child, or both. If the foetus is viable, the operation is called "induction of premature labor;" if not viable, it is called "induction of abortion." As foetal viability is usually reckoned from the end of the seventh month, that date may be considered the dividing-line between the two operations. Artificial *abortion* aims to save the mother at the expense of the child; artificial *premature labor*, to save both if possible, or the child at least if the mother's death is inevitable.

HISTORICAL NOTE.—Abortion is one of the oldest obstetric operations, having been practised more or less from very early times. Among the ancients the foetus *in utero* was looked upon as part of the mother's body,¹ and among some nations its destruction was not only allowed, but even sanctioned, as a means of improving the race or keeping down surplus population. Although at times the value of the operation as a therapeutic measure seemed to be dimly recognized, it is nevertheless quite plain that up to the Christian era its scope was upon the whole destructive rather than conservative. But from the very first the Christian Church upheld the rights of the unborn child and put abortion on a par with infanticide.² As Christianity spread over Europe the practice of abortion gradually died out, till at last it survived only among the Arabians as an expedient in deformity of the pelvis. Justine Siegmundin (1690), Puzos (1707), and Bohn (1717) advised the induction of premature labor by puncturing the membranes in cases of

¹ Lecky says: "The general opinion among the ancients seems to have been that it was but a part of the mother, and that she had the same right to destroy it as to cauterize a tumor upon her body. Plato and Aristotle both admitted the practice. The Roman law contained no enactment against voluntary abortion till the time of Ulpian. The Stoics thought the infant received its soul when respiration began. The Justinian code fixed its animation at forty days after conception. In modern legislations it is treated as a distinct being from the moment of conception."—*History of European Morals*, vol. i. p. 92.

² Lecky's *History of European Morals*, vol. ii. pp. 24-34.

placenta prævia. In England it was first used by Cooper (1717) as an alternative to Cæsarean section. But whatever credit may be due elsewhere for suggestions and recommendations, to English obstetricians undoubtedly belongs the chief honor of recognizing the true value of the operation, defining its just limitations, and legitimizing it as a truly conservative resource. It had occasionally been observed that women with pelves too contracted to permit the birth of a living child at full term sometimes bore living children at the seventh or eighth month. It was proposed, therefore, to imitate nature in such cases and induce labor artificially, in the hope of saving the child and avoiding the horrors of craniotomy or the old Cæsarean section. The proposal aroused public and private interest to such an extent that finally, according to Denman, a meeting of eminent obstetricians was held in London (1756) "to consider the moral rectitude of, and the advantages which might be expected from, this practice." The warm indorsement of that influential meeting at once gave the operation a status in England. Shortly afterward it was performed successfully by Macaulay upon the wife of a London tradesman. Championed by such men as Denman, Marshall, and Ramsbotham, it soon became firmly established. From Great Britain it passed over to Germany, where it was proposed by Mai of Heidelberg (1799) and Weidmann, and first practised by Wenzel (1804). In 1818, Reisinger's monograph secured its general adoption. From Germany it extended to Holland, Italy, Denmark, Switzerland, and other countries. In France, where the power of the Church¹ was strong, it was long discountenanced as unjustifiable and even criminal. In 1779 it was proposed by Roussel de Vauzemes, but defeated by the bitter opposition of Baudeloeque and his school. In 1827 it was, through his influence, formally rejected by the Academy of Medicine. Its next champions were Foderé (1830) and Burekhardt, and the first successful French operator was Stoltz of Strassburg (1831). The powerful advocacy of Dubois, and later of Dezeimeris, Lacour, Ferniot, Lazare Sée, and others, finally succeeded in overcoming religious opposition and legitimizing it in France morally as well as legally.

INDICATIONS FOR THE INDUCTION OF ABORTION.

The safety of the mother may require the arrest of gestation before the child becomes viable. The life of the fœtus is dependent upon that of the mother; if the mother is allowed to perish, the fœtus must perish with her. For the fœtus the result will be the same in grave cases, whether abortion be induced or not: it will perish in either event. But for the mother it is entirely a different matter: her life may be

¹ The dictum of the Roman Catholic Church was: "Si l'on ne peut tirer l'enfant sans le tuer, on ne peut sans péché mortel le tirer."

saved by the speedy arrest of gestation. Whenever such is the case interference is not only legitimate, but becomes actually imperative. In general terms, then, it may be said that the induction of abortion is justifiable (1) whenever there is such mechanical obstruction that the birth of a viable child is impossible; (2) whenever the mother is suffering from such grave disease that her life is in imminent peril and can be saved only by the arrest of gestation.

1. MECHANICAL OBSTRUCTION.—The most important forms are—

Pelvic Contraction.—When the conjugate of the brim is under 6 cm. (2.36 in.) the induction of abortion is indicated. The alternatives are craniotomy and Cæsarean section at a later period. Craniotomy somewhat increases the mother's risks, while it is no better for the child; the modern Cæsarean section gives the child a fair chance, but endangers the mother. In those rare cases where osteomalacia causes the pelvic contraction the softened bones may yield sufficiently to allow a viable child to pass. In such cases it is safe to wait for viability.

Tumors, pelvic, uterine, or ovarian, which block up the pelvis and mechanically impede the course of labor, if they cannot be displaced or removed.

Cicatricial contraction of cervix or vagina, if incapable of sufficient dilatation to allow the passage of a viable child.

Carcinoma of the uterus or vagina.

Certain displacements of the womb, rendered irreducible by firm adhesions to the surrounding parts, such as procidentia, retroflexion, or retroversion, particularly if there is any tendency to uræmic complication.

Fixation of the uterus by adhesions.

2. URGENT DISEASE COMPLICATING PREGNANCY, such as—

Vomiting which has resisted all other treatment, local and medicinal, especially if accompanied by progressive emaciation and a persistently high pulse. In such cases it is always wise to interfere in good time, before the patient's strength is too far spent.

Grave heart and lung troubles, with severe dyspnœa, such as aneurism, valvular disease, pleurisy, œdema, etc.

Pernicious anæmia, according to Breisky.

Hæmorrhages which are exhausting the patient and do not yield to treatment.

Albuminuria,¹ with threatened eclampsia, and exceptionally *hydramnios*, *chorea*, *insanity*, *advancing jaundice* with diarrhœa, etc.

¹ In the discussion on "Intra-uterine Death" at the Glasgow meeting of the British Medical Association (August, 1888), Dr. Barnes argued strongly in favor of inducing premature labor when marked albuminuria occurs in advanced pregnancy. He believes albuminuria to be a common cause of intra-uterine death, and thinks that interference in such cases will benefit both mother and child—the former by warding off eclampsia, the latter by preventing intra-uterine death.

Nature often shows us the rational treatment in such cases; the overburdened organism avoids a breakdown by throwing off the cause of its troubles.

INDICATIONS FOR THE INDUCTION OF PREMATURE LABOR.

The operation is indicated when the further continuance of pregnancy or labor at full term would expose mother or child to serious risks which might be diminished or avoided by the artificial arrest of gestation.

1. PELVIC DEFORMITY of such a nature as to prevent the birth of a living child at full term, and yet allow the safe delivery of a premature viable child, is one of the commonest indications. In such cases there is a disproportion between the mother's pelvis and the mature fœtus which must be overcome before safe delivery is possible. The head is too large for the pelvis, and as the size of the pelvis cannot be increased, it only remains to reduce the size of the fœtal head by provoking labor when it is smaller and more plastic. Practically, a distinction must be made between the common *flat pelvis* and the rare *generally-contracted pelvis*. In the former only the conjugate is narrowed, and a seven months' fœtus may be delivered safely through a conjugate of about 7.6 cm. (3 in.) or even sometimes 7 cm. ($2\frac{3}{4}$ in.). Schroeder places the lowest limit at 6.75 cm. (2.66 in.). In the latter the lateral measurements are contracted as well as the conjugate, and a conjugate of 8 cm. (3.15 in.) is required. Korn of Dresden says that labor may be safely induced between the thirty-second and thirty-sixth weeks in *flat* pelvis with a conjugate of 7 cm. ($2\frac{3}{4}$ in.), or in *generally-contracted* pelvis with a conjugate of 7.6 cm. (3 in.). Theoretically, the indication seems clear enough, but practically there are several important difficulties. In multiparæ the history of previous labors is usually a pretty safe guide; the indication is clear if on a former occasion craniotomy had to be performed, or there was great difficulty in delivery on account of pelvic contraction resulting in the death of the child. But in primiparæ the problem is not so easy, for we have not the experience of previous labors to guide us nor the measurements of previous children's heads. The practitioner should always inquire carefully into the personal and family history of his primiparous patients. If he finds any history of rickets, spinal curvature, hip disease, or any accident, injury, or disease liable to affect the shape or capacity of the pelvis, he should measure it at once.

Unfortunately, our people have not yet come to realize the practical importance of prophylaxis in obstetric matters. If patients would only place themselves under the charge of their medical attendants early in the course of their pregnancy, much suffering would be prevented, many lives saved, and dystocia and eclampsia robbed of half their terrors.

Another important difficulty arises when the time for operating has to be decided upon. We are unable in most cases to determine the date of conception, and yet this must be done approximately if we are to mark out correctly the limits of viability. If through miscalculation we operate too soon, the child will be lost; if too late, both lives may be placed in peril. Besides the degree of pelvic contraction, the size and plasticity of the foetal head must be approximately made out. Schroeder measured the transverse diameter of the head in 68 cases of premature delivery where the period of gestation was accurately known, and found it to be larger than usually stated.¹ On the average his measurements showed—

In the 36th to 40th week	8.83 cm. (3.48 in.).
“ 32d “ 36th “	8.69 cm. (3.42 in.).
“ 28th “ 32d “	8.16 cm. (3.19 in.).

The relatively large size of the head is partly counterbalanced, however, by its increased plasticity and compressibility. From the measurements of Burns, Salomon, Dubois, Stolz, Tarnier, and Budin, the biparietal diameter of the foetal head is²—

At full term	9 to 9½ em. (3.54–3.74 in.).
“ 8½ months	8½ em. (3.35 in.).
“ 8 “	8 em. (3.15 in.).
“ 7½ “	7½ em. (2.96 in.).
“ 7 “	7 em. (2.76 in.).

In young primiparæ the transverse diameter is relatively smaller than in older multiparæ, and the weight of the children seems generally to increase with the age of the mother and the number of previous births. Ahlfeld judges approximately of the length of the foetus and the size of its head by measuring the length of the foetal ovoid, but this method is open to so many errors that it cannot be relied upon as giving positive indications in individual cases. Müller (Bern) determines the relative proportions between the foetal head and the pelvis by pressing the head down into the pelvis every eight days, and ascertaining by means of the fingers in the vagina whether the head can be made to enter the brim. Whenever it becomes hard to force the head into the brim it is time to operate.³

2. CERTAIN DISEASES which endanger the mother's life, induction of premature labor affording the best chance of averting the danger.

Placenta Prævia.—Whenever the diagnosis is made operative measures are usually required. If the child is not yet viable and the symptoms are not urgent, rest in bed and sedatives may tide the patient

¹ *Lehrbuch der Geburtshilfe*, 1886, S. 263.

² Charpentier: *Traité pratique des Accouchements*, tome ii. p. 704.

³ *Centralblatt für Gynäkologie*, Bd. ix. S. 660.

safely along till there is a fair prospect of saving the child. But it must always be borne in mind that in placenta prævia, when hemorrhage has once taken place, the patient is never safe till labor is over.

Eclampsia.—Some difference of opinion exists as to whether labor should be induced at once or an expectant plan adopted. If the child is not viable and the convulsion not severe, there is no harm in putting the patient on suitable treatment and waiting in the hope of saving the child; but in the great majority of cases it is better practice to induce labor and deliver as soon as possible. Of course the operation must be done carefully and gently, with as little manipulation as possible, and always under an anæsthetic. The convulsions do not usually recur after labor is over; but if they do, they are generally fewer and milder. The induction of labor when eclampsia is threatening, but has not yet occurred, is an open question which must be settled according to the circumstances of the individual case.

Chorea, grave heart and lung troubles, uncontrollable vomiting, jaundice, general œdema, excessive œdema of vulva, suppression of urine, and other grave diseases occasionally make the induction of premature labor advisable.

3. When a *dead fetus* remains *in utero* and is becoming a source of trouble, labor must be induced and the uterus thoroughly cleared out.

4. The operation has sometimes to be performed in the interests of the child, as when on a previous occasion a child has perished on account of the large size of its head or the unusual ossification of its cranial bones, or when death of the fetus has habitually taken place during the last weeks of pregnancy.¹

5. In those rare cases where the death of one twin occurs toward the end of pregnancy the induction of labor as soon as that fact has been discovered may save the life of the surviving child.

6. When the mother is likely to die before the completion of her full term it has been proposed to operate in the interest of the child, and thus avoid a post-mortem Cæsarean section. No rule can be laid down in such cases; the individual circumstances and the wishes of the patient and her friends must largely influence the course of action.

TIME TO OPERATE.—Charpentier² says that the fetal head may be safely compressed 1 cm. (.39 in.),³ and lays down the following rules for the selection of the proper time for operating:

1. In pelves with a conjugate of at least 9 cm. (3.54 in.), the fetal

¹ When the habitual death of the fetus is caused by anemia or chlorosis of the mother or changes in the cord or placenta, the operation may be of service; but when syphilis is the cause it will be of no use.

² *Traité pratique des Accouchements*, tome ii. p. 708.

³ Bandeloeque believed it possible to diminish the transverse diameter of the fetal head by compression to the extent of a third or a quarter of an inch with safety to the child.

head at term being 9.5 cm. (3.74 in.), and being reducible 1 cm. (39 in.), labor should be induced in multiparæ between eight and a quarter and eight and a half months, according to the difficulty experienced in former labors and the estimated size of the fœtus: in primiparæ, the child being probably smaller, labor may be induced eight to ten days before full term, or even at full term.

2. In pelves of 8.5 cm. (3.35 in.), in multiparæ as well as primiparæ, labor should be induced between eight and eight and a half months.

3. In pelves of 8 cm. (3.15 in.), between eight and eight and a half months at the very latest.

4. In pelves of 7.5 cm. (2.95 in.), between seven and a half and eight months.

5. In pelves of 7 cm. (2.76 in.), between seven and a half months and seven and three-quarters.

6. In pelves of 6.5 to 6 cm. (2.56 to 2.36 in.), at seven to seven and a half months at the latest.

7. Below 6 cm. (2.36 in.) abortion should be induced, since it is very exceptional to get a living child through a pelvis below $5\frac{1}{2}$ cm. (2.17 in.), and then cephalotripsy or embryotomy would be dangerous for the mother.

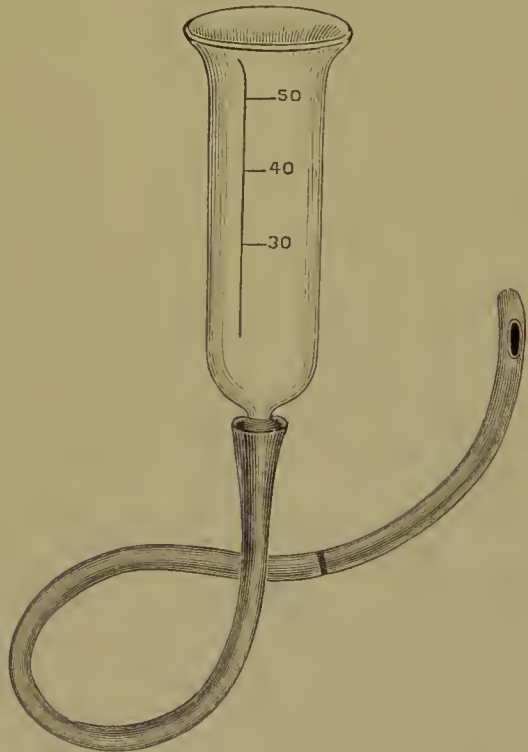
At an earlier period of gestation than the two hundredth day the viability of the child is improbable; between the two hundredth and two hundredth and thirtieth day it is doubtful; after the two hundred and thirtieth day it becomes probable. Usually, two hundred and forty to two hundred and fifty days from the cessation of the last menstrual period should be allowed to elapse before operating. If the pelvic contraction is great, it is better to err upon the safe side and operate too early rather than too late; if the contraction is moderate or slight, the operation should be deferred as long as possible. Schroeder usually operated in the thirty-sixth week, almost never before the thirty-fourth.

PROGNOSIS.—For the mother it is usually good, but should be guarded. The mechanism of provoked labor differs somewhat from that of normal labor. Gestation being incomplete, the preparations for labor are also incomplete: the uterus is immature, its contractile power less, its cervix harder and less dilatable, and abnormal presentations are more likely to occur. More manual interference is needed, and there is a greater risk of septic infection. The patient's general condition too is often bad; concurrent disease may complicate the result or be aggravated by the operation, so that the prognosis for the mother depends a great deal upon the cause which necessitates interference. The excitability of the uterus is another factor which must be taken into account: it varies greatly in different women; in some the slightest irritation will precipitate labor, while in others the uterus

will scarcely respond to the most powerful stimuli. Danger does not always end when labor is completed: there are still many risks to run. The possibility of septic infection has always been a source of anxiety, but the perfecting of our antiseptic methods has reduced this to a minimum, so that now the maternal mortality from sepsis need be practically *nil*.

For the Child.—The younger the child the worse the prognosis. Between the thirty-second and thirty-sixth weeks the greatest care will be needed to preserve its life. But the wonderful improvements made by Tarnier and others in the artificial rearing of feeble infants very materially increase the chances of premature children, and may be said to have pushed back the limit of viability from the seventh to the sixth month. At La Maternité, Tarnier places feeble or premature infants in an incubator (*couveuse*) (Fig. 221, Vol. I. p. 535), which he keeps supplied with fresh air at a constant temperature of 85°–95° Fahr.; at the same time artificially feeding by means of a rubber tube (*gavage*) (Fig. 65) is methodically carried out. The results, as reported by Budin in a recent article in *La Semaine Médicale* are simply marvellous. With Tarnier's *couveuse* and *gavage* they have succeeded in saving—

FIG. 65.



Tarnier's Apparatus for the Artificial Feeding of Premature or Feeble Infants (*gavage*); Lürer's Model.

Children at six months	30.0 per cent.
" " seven "	63.6 "
" " eight "	85.7 "

Budin predicts that by further improvements in the rearing of premature children the mortality will be so much reduced that the artificial induction of premature labor will eventually replace craniotomy and Cæsarean section in all but the extreme degrees of pelvic contraction. Dr. Max Stauch¹ gives the statistics of the Moscow Clinic, and com-

¹*Arch. f. Gyn.*, Bd. xxxi, Hft 3.

pares the maternal and foetal mortality after premature labor and Cæsarean section as follows :

	Premature Labor.	Cæsarean Section.
Mother	0 per cent.	11.8 per cent.
Child	55 “	8 “

Prof. Leopold and his assistants, Korn, Löhman, and Präger, tabulate the statistics of the Dresden Clinic for four years, and compare the relative maternal and foetal mortality after induction of premature labor, turning, craniotomy, and Cæsarean section.¹ In the forty-five cases where premature labor was induced,

- 35 mothers recovered without fever.
- 9 “ had slight elevation of temperature for two or three days.
- 1 “ died from sepsis.

	Maternal Mortality.	Foetal Mortality.
Induced labor	2.2 per cent.	33.3 per cent.
Version and extraction	4.8 “	41 “
Craniotomy	2.8 “	100 “
Cæsarean section	8.6 “	13 “

Septicæmia was the cause of foetal death after

Induced labor	in 2.2 per cent.
Version and perforation	“ 0.0 “
Perforation	“ 0.0 “
Cæsarean section	“ 4.3 “

Wyder of Berlin analyzes 9000 cases of labor at the Charité and 6000 at the Polielinie, and compares the results of induced labor, craniotomy and Cæsarean section.² There were 306 cases of induced labor, with a maternal mortality of 3.9 per cent. ; in the higher degrees of pelvic contraction none of the mothers were lost. He concludes that in contracted pelves the mortality after

Cæsarean section is 2.13 times greater than after craniotomy.
“ “ 3.27 “ “ “ “ induced labor.

For the relative indication (moderate contraction) the Cæsarean section shows a mortality 7.1 times greater than that after induced labor in highly-contracted pelves (5.5–7 cm.—i. e. 2.17–2.76 in.). He thinks that in highly-contracted pelves labor should be induced in the early months, for experience has shown that then the operation can be performed without risk to the mother if proper antiseptic precautions be adopted; but when pregnaney is far advanced Cæsarean section is indicated. He thinks this should be the rule of practice till the mortality

¹ *Der Kaiserschnitt und Seine Stellung zur kunstlichen Frühgeburt, Wendung, und Perforation bei engem Becken.*
² *Archiv f. Gyn.*, Bd. xxxii. Hft. 1.

after Cæsarean section has been reduced at least approximately to that after induced labor.

OPERATION.

Schroeder used to say that the English introduced the operation, but the Germans have formulated its indications and perfected its technique. The methods employed are either (I.) *medicinal* or (II.) *mechanical*.

I. MEDICINAL.—From time immemorial drugs have been used to provoke abortion. They act upon the uterus either directly or indirectly through the spinal centres. Hot climates seem to increase their efficiency. Drugs as abortives are unsafe as well as unreliable, and should never be employed to *provoke* uterine action, though occasionally they may be used to *intensify* it when present. The drugs which have been most commonly employed are ergot, quinine, savin, rue, borax, hamamelis, cinnamon, jaborandi, muriate of pilocarpine.

II. MECHANICAL.—These agents act either by direct mechanical dilatation or by stimulating the peripheral nerves.

1. *Puncturing the membranes* is probably the oldest method; it was the one used by Justine Siegmundin and the early English operators. Scheel the Dane recommended it in 1709, and on the Continent it is usually known as “Scheel’s method.” By means of a sound, sharpened goosequill, or some pointed instrument the membranes are punctured opposite the os uteri; the waters then drain away, the uterus contracts about its contents, the utero-placental circulation is disturbed, and regular uterine action is by and by set up. Scheel’s method is most useful when the size of the uterus is to be reduced quickly. The objection to it is that the rapid discharge of the waters before the os and cervix have dilated is apt to make labor more tedious and painful for the mother, as well as more dangerous for the child.¹ To overcome this difficulty Hopkins (1826) advised tapping the membranes some distance above the os, so that the liquor amnii might drain slowly away while the os and cervix were dilating. Meissner constructed a long curved trocar for the high puncture of the membranes, but his instrument never became popular, and the sound or the Vienna goosequill is in general use.

2. *Introduction of an elastic bougie into the uterus*, known usually as “Krause’s method,” is on the whole the safest and best. Mamppe (1838) recommended a flexible catheter to be passed up between the uterine wall and membranes several times in different directions, and

¹ These objections do not apply with as much force to the induction of abortion where the child’s life is not considered as they do to premature labor. The membranes are not any more likely to be retained than in a spontaneous abortion, and the treatment of retention is the same in both cases.

then withdrawn. In Holland, Lehman passed a bougie in a similar manner, but did not leave it in the uterus. Krause of Gröningen improved upon these methods by leaving the catheter in the uterine cavity till labor has fairly begun. It is better to use a solid bougie than a gum-elastic catheter, so that there may be less danger of air or septic matters finding their way into the uterus. If a catheter is used, its openings should be carefully closed with sealing-wax. The bougie or catheter should be new and kept immersed in a carbolic-acid solution till required for use. The strictest attention must be paid to antiseptic details during the operation.¹ The hands and arms should be carefully disinfected, a hot vaginal douche (sublimite or carbolic) administered, two fingers passed into the vagina up to the internal os, the bougie slipped along them as a guide into the cervix and through the internal os, and then made to work its way gently between the uterine wall and the membranes several inches up toward the fundus. During the introduction of the bougie, the membranes may be injured and the liquor amnii drain away; Scheel's method has thus been accidentally performed. The bougie is kept *in situ* by a vaginal tampon of iodoform gauze, which also acts as a plug to keep out air and septic matters. Labor usually begins in from four to twenty-four hours. In exceptional cases the uterine irritability is so slight that the bougie may remain *in utero* for days without provoking contraction. In one case fourteen days were insufficient to induce labor, and other means had to be tried. The method is simple, efficient, easily executed, and perfectly safe if antiseptic rules are strictly observed.

3. *Intra-uterine Injections*.—This method was first recommended by Schweighäuser (1825) and simplified by Cohen (1846), and now usually bears the latter's name. A special nozzle or an elastic catheter is introduced between the uterine wall and the membranes, just as in Krause's method; lukewarm water is then injected till the patient complains of tension. The membranes are thereby detached over a considerable area, and strong labor-pains soon begin. Though undoubtedly the method is efficient, it is objectionable on account of its danger: several fatal cases have been reported from shock and entrance of air into the uterine veins. More dangerous still is Lazarewitch's plan. He carries the nozzle right up to the fundus before injecting, because the seat of greatest uterine irritability is at the fundus.

4. *Vaginal and uterine irrigation*, commonly known as "Kiwisch's method." A stream of hot water² is allowed to play against the cervix

¹ For detailed account of antiseptic measures to be taken in the conduct of natural labor and obstetric operations, see Dr. Garrigues' article, p. 290.

² Some prefer a cold douche; others administer a hot douche to relax the parts, followed immediately by a cold douche, so that the sudden change of temperature may arouse uterine action.

for ten or fifteen minutes at a time, every two or three hours, till pains begin. The temperature of the water is variously recommended to be from 100° to 120° Fahr. The method is tedious and painful and apt to cause troublesome congestion; it has occasionally produced metritis, shock, and even death. On the Continent uterine irrigation is frequently used to soften the cervix and make it more dilatable before Krause's method is employed. Stauch of Moscow has shown that such practice is wrong, because douching tends to lower uterine irritability and retard the action of the bougie instead of helping it.¹ In his experience Krause's method always acts rapidly and well if the irritability of the uterus has not been previously blunted by Kiwisch's hot douche.

5. *Tamponing the Vagina.*—Braun's colpeurynter is occasionally of service when there is hemorrhage, particularly in placenta prævia: it is used also to strengthen pains which are getting feeble or to oppose counter-pressure to a presenting bag of membranes which we wish to keep from rupturing. The colpeurynter (Fig. 66) is a rubber bulb with a supply-tube, something like an ordinary water-pessary. A No.

FIG. 66.



Braun's Colpeurynter, dilated.

FIG. 67.



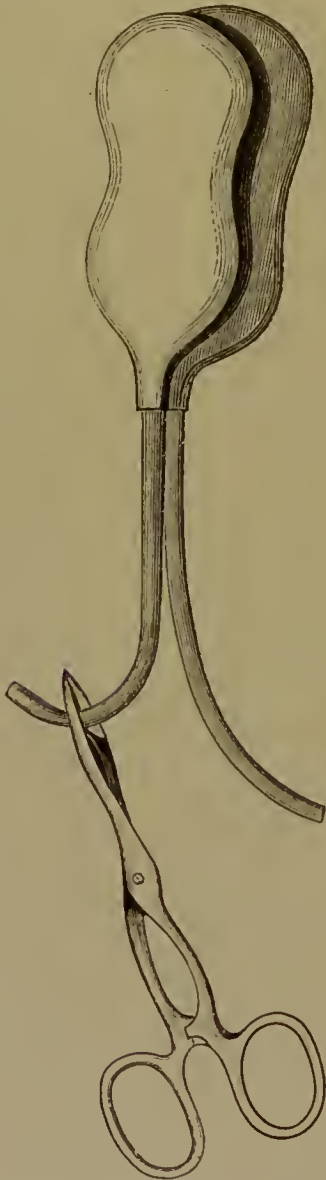
Barnes' Fiddle-shaped Hydrostatic Bag, made in three sizes—a better model than that in Fig. 271, Vol. 1. p. 708.

3 or 4 water-pessary answers the purpose of a colpeurynter very well. It is introduced collapsed up to the cervix, and then inflated with hot or cold water. It is useful as an auxiliary means, but is too slow, painful, and uncertain to depend upon alone.

¹ *Archiv f. Gyn.*, Bd. xxxi. Hft. 3, S. 385.

6. *Dilatation or Irritation of the Cervix.*—Steel dilators, sponge tents, laminaria tents, and elastic bags have at various times been proposed

FIG. 68.



McLean's Modification of Barnes' Hydrostatic Bags: one compartment is dilated and secured by a pair of compression-forceps; the other compartment is undilated.

FIG. 69.



McLean's Bags, both compartments dilated.

for this purpose. Hard dilators are apt to injure the parts, tents are apt to cause sepsis, and elastic dilators are useful only after labor has been excited in some other way and the cervix is already somewhat dilated. Barnes' fiddle-shaped bags (Fig. 271, Vol. I. p. 708, and Fig. 67) or Mc-

Lean's modification of them (Figs. 68, 69) are occasionally very useful in hastening dilatation of the cervix in urgent cases of placenta prævia. Tarnier's intra-uterine dilator (Figs. 70, 71, 72) or Pajot's modification of it is much used in France, and is there highly spoken of.

If the bulb is not sufficiently inflated, it is apt to be forced out of the cervix before labor is fairly started; and if too much inflated, it is apt to burst during any violent effort, such as coughing or vomiting, or even by the force of the labor-pains themselves. Tarnier's dilator is not likely to come into general use.

7. *Electricity*.—The faradic current was proposed by Herder (1803), and successfully employed by Hörniger (1844) and Jacoby. The galvanic current was adopted by Schrieber (1844). The use of electricity for this purpose never became general, and for a time was entirely dropped, but recently attention has been again directed to it. The mild faradic current is, on the whole, to be preferred. The negative pole is applied to the cervix in the posterior vaginal cul-de-sac, while the positive pole is placed over the sacrum or lumbar vertebræ.

FIG. 70.



FIG. 71.

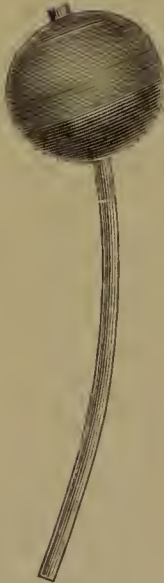


FIG. 72.



FIG. 70.—Tarnier's Cervical Dilator (Mathieu's model), unexpanded, ready for introduction into the uterus.

FIG. 71.—Tarnier's Dilator, expanded.

FIG. 72.—Tarnier's Dilator, *in situ*.

Care must be taken not to pass the current through the poles of the foetal ovoid. The method is worthy of trial.

8. *Aspiration of the Uterus per Vaginam*.—Occasionally the ordinary

methods fail to induce abortion. If the case is pressing, nothing then remains but to puncture the uterus and aspirate the ovum. The fundus might be punctured *per rectum*, but there would be great risk of septic infection. The safest plan is to select, *per vaginam*, the most prominent portion of the uterine body and introduce the aspirator-needle at right angles to the uterine wall. When the waters have drained away uterine contraction closes the puncture, and if strict antisepsis has been observed there will be very little difficulty, except that abortion is apt to be incomplete.

Many other methods of very doubtful value have been proposed, such as D'Outrepoint's friction of the fundus and body of the uterus, together with a course of baths and purgatives; Ritgen's rubbing of the os uteri; Hamilton and Merriman's detachment of the membranes from the lower segment of the uterus by means of the finger or a female catheter; irritation of the mammae by sinapisms or blisters or by rubber suction-bulbs applied to the nipples.

When it is desired to conclude labor at a certain predetermined hour Barnes' plan should be tried. Over-night he *provokes* labor by passing a bougie, as in Krause's method; the next afternoon he uses what he calls his *accelerative* measures. Applying a binder to the abdomen so as to keep the head closely applied to the cervix, he introduces a small Barnes' bag and dilates to the size of three or four finger-breadths. Then he ruptures the membranes, and before the waters have all drained away inserts the large-sized bag and dilates till there is room for the child to pass. The case is then left to nature or terminated by forceps, turning, or craniotomy according to circumstances. During the puerperal period the patient will need the most watchful care.

Premature induction of labor is always a grave proceeding, and should not be undertaken without the most careful consideration. It is unwise for a physician to shoulder the whole responsibility of advising and operating if he can obtain the moral support and assistance of a confrère; whenever it is possible a consultation should be held. Besides the purely medical aspects of the case, there crop up sometimes moral and religious questions which are quite out of the province of the medical attendant. After the case has been clearly stated to the patient and her friends, the decision of such questions should be left to them and their religious advisers. If a practitioner has any regard for his own peace of mind, he will not operate till he has obtained the full and free consent of both family and consultants.

VERSION.

By JAMES C. CAMERON, M. D.,

MONTREAL.

Version, or *turning*, comprehends all those manipulations by which the long axis of the fœtus *in utero* is brought into coincidence with that of the pelvis, and a favorable presentation substituted for one that was relatively unfavorable. Either the *cephalic* or *pelvic* pole may be caused to present; a transverse presentation may be turned either to the head or breech; a breech presentation may be turned to the head or a head presentation to the breech. After version proper has been performed the case may be left to nature or else terminated by artificial extraction.

HISTORICAL NOTE.—1. *Cephalic version* is the most ancient, and at the same time the most modern, method of turning. Even in the earliest times we find attempts being made to convert unfavorable presentations into those of the vertex. Hippocrates taught that the fœtus could not be delivered otherwise than head first; this doctrine, long prevalent, was opposed by Celsus, but afterward reaffirmed and propagated by Galen. The older methods of turning were rude and barbarous, and apparently attended with only moderate success, for we find Albucasis writing as late as 1122 that version will succeed “in case it please God.” The Arabians turned all other positions to the head; in cross-births the prolapse of an arm seemed to give them very little uneasiness; they simply cut off enough to make room for the descent of the head. In Europe it¹ remained a favorite operation till the middle of the sixteenth century, but after that time it gradually gave way to podalic version, which was introduced by A. Paré (1550). The opposition of Mauriceau (1688) and De la Motte (1721) for a time virtually banished it from France. Velpeau says that in the seventeenth and the beginning of the nineteenth century cephalic version was rarely mentioned unless to be condemned. Justine Siegmundin (1690) recommended cephalic as preferable to podalic version in some cases. She was probably the first to understand partially the relative merits of the two operations. Deventer (1710) recommended cephalic version

¹ Rhodion says that when one foot presents it should be pushed back, and the woman, lying head downward, should writhe and struggle and toss herself about, so that the head may come down.

before rupture of the membranes. In England, Smellie (1751) tried it, but soon gave it up; Aitken (1784) maintained that podalic version should never be tried till it is evident that cephalic version is no longer possible. The general revival of the operation dates from the beginning of the present century, and is mainly due to the efforts of two men, Flamant of Strasburg (1795 to 1803) and Wigand of Hamburg (1803 to 1807). Flamant practised the *internal* method, Wigand the *external* method with posturing. Wigand, having observed some cases of spontaneous version, strove to imitate artificially what he had seen occur naturally. After the appearance of his monograph cephalic version by the external method became popular in Germany, and has ever since been a favorite operation there. In France, Hergott's translation of Wigand's book (1851) first directed general attention to the operation, and its ultimate success was secured by the powerful advocacy of Tarnier and his pupils, Chantreuil, Budin, and Pinard. In England and America it never took firm root, and only recently can it be said to have taken its proper place among obstetrical operations. Though Wigand's book was known to Rigby (1841), Churchill (1842), and Ramsbotham (1844), the operation was scarcely mentioned by them. Indeed, it was not till Braxton Hicks (1860-63) announced his combined method of external and internal version that general attention was called to the possibilities of cephalic version. It now receives the sanction of most obstetricians in England and America.

2. *Podalic Version*.—Before the Christian era cephalic version was the only method of turning in use, breech as well as transverse presentations being, if possible, turned to the head. Though Celsus (30 B. C.—14 A. D.) recommended podalic version if the fœtus is dead, Soranus (98-117 A. D.) was the first to advocate it if the fœtus is alive. Though the teachings of Soranus were accepted by Moschion (117-138 A. D.), Galen (131 A. D.), and others, they were not generally adopted, for Tertullian (200 A. D.) writes that in transverse presentations embryotomy must be performed if cephalic version is not practicable. After the fall of Rome the darkness of the Middle Ages settled over Europe, and medicine shared the fate of science and letters. Through the influence of ignorance and superstition the practice of obstetrics was divorced from that of medicine and surgery, and fell into the hands of untrained, uneducated midwives. With the dawn of better days, however, it slowly regained its old status. Cephalic version was evidently known to a few, but podalic version was practically unknown till the time of A. Paré (1550). To him belongs the credit of having restored the operation, and practised it even in head presentations when labor had to be terminated rapidly. His pupil Guillemeau (1609) improved its technique and formulated its indications. The new operation gained rapidly in public favor till from the time of

Mauriceau (1668) it practically superseded cephalic version. Portal (1685) was the first to recommend bringing down one foot instead of two, and Puzos (1753) explained why delivery as a half-breech is more favorable for the child than as a complete footling. Ould of Dublin, the second master of the Rotunda, was the first to recommend podalic version as an elective operation in cases of pelvic deformity (1739-42). Among the early operators version was immediately followed by extraction till Deleurye (1770) pointed out that version really comes to an end when rotation is complete, and that extraction is a supplementary procedure with indications and contraindications of its own. Similar ground was taken by Denman in England (1788) and Boër in Germany (1791). Although Wigand and others had recognized the principle of combined external and internal manipulation, and had adopted it in cephalic version, Braxton Hicks (1860-63) was the first to describe definitely a combined method applicable to both varieties of version even before the os is fully dilated. In using his method it is not necessary to introduce the hand into the uterine cavity, but as soon as one or two fingers can be passed through the os and cervix a foot or knee can be seized and drawn down. Braxton Hicks' method is the crowning glory of podalic version, and deservedly ranks as one of the most important advances in conservative midwifery achieved during this century.

NOMENCLATURE.—Confusion in nomenclature is undoubtedly responsible for much of the haziness of professional opinion regarding version. For example, I have found Braxton Hicks' method of turning in cases of placenta prævia variously described by different writers as—(1) combined internal and external version; (2) combined internal and external podalic (or pelvic) version; (3) combined podalic (or pelvic) version; (4) bimanual podalic version; (5) combined bimanual podalic version; (6) combined bipolar version; (7) combined internal and external bipolar version; (8) combined bipolar podalic (or pelvic) version; (9) bipolar podalic (or pelvic) version; (10) combined internal and external bipolar podalic (or pelvic) version. Is it any wonder that many practitioners have a hazy idea of what Braxton Hicks' method really is? It is not at all necessary to adopt a cumbersome or confused nomenclature: it may be made very simple.

1. As the foetal ovoid has but two poles, the *cephalic* and the *pelvic*, the foetus must be turned to one or other of them: when it is turned to the head the operation is called *cephalic* version; when turned to the breech, *pelvic* version. *Podalic* version, or turning to the feet, is a variety of *pelvic* version, and should be classed as such.

2. Version is performed by *external* manipulations only, by *internal* manipulations only, or by *external* and *internal* manipulations combined. The method of operating may be described, therefore, as *exter-*

nal or *internal* or *combined*. Hence all cases of version may be classified as

External,	}	Cephalic	}	Version.
Internal, or		or		
Combined		Pelvic (podalic)		

Bimanual means that both hands are used, but as both hands should be used in all cases, the term is superfluous. *Bipolar*, a term proposed by Barnes, means that during turning the two poles of the fœtus are acted upon simultaneously or alternately by the two hands, each of which controls one pole. A *bipolar* version must therefore be *bimanual*, though a *bimanual* version need not be *bipolar*. The term *bipolar* is useless and often misleading, for certainly the combined method of Braxton Hicks cannot be correctly described as either a *bipolar* or a *combined bipolar* version.

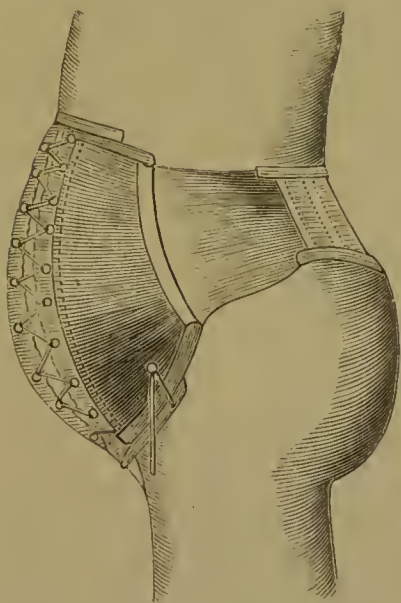
I. CEPHALIC VERSION is usually performed in order to improve or rectify a relatively unfavorable position; it is not often employed when speedy delivery is imperative. It is easier when done early, and more likely to succeed when the membranes are unruptured, the os not fully dilated, and the pains not yet regular or strong; although ruptured membranes, a well-dilated os, and strong pains do not necessarily make success impossible. The nearer the head lies to the os, the more easily can it be made to present.

Indications.—Pinard, one of the chief advocates of external cephalic version, maintains that if the fœtal head has not entered the brim by the end of the eighth month we may infer that the accommodation between it and the pelvis is abnormal, incomplete, or altogether faulty. If at that time it occupies either iliac fossa or the superior segment of the uterus, it is in the wrong place and must be set right: in a word, if during the last month of gestation the fœtal head is not in the excavation, it must be put there.¹ When the head has been made to engage in the brim a strong abdominal supporter is applied to keep it in position (Figs. 73, 74). In multiparæ, if at the end of the eighth month the fœtal head is not in the excavation, even though situated in the lower segment, he applies his abdominal supporter to force it down and prevent it from being accidentally displaced. By this means he hopes to correct or prevent all shoulder, breech, and face presentations, and have nothing but normal presentations of the vertex. If the operation is to succeed, a precise diagnosis must be made of the position of the fœtus *in utero*, the uterus itself must not be too irritable, the fœtus must be sufficiently movable, and when version is complete the vertex must be kept *in situ* till active labor has fairly begun.

¹ "Si dans le dernier mois de la grossesse, la tête du fœtus n'est pas dans l'excavation, il faut et on peut l'y mettre" (*Traité du Palper abdominal*, Pinard, p. 222).

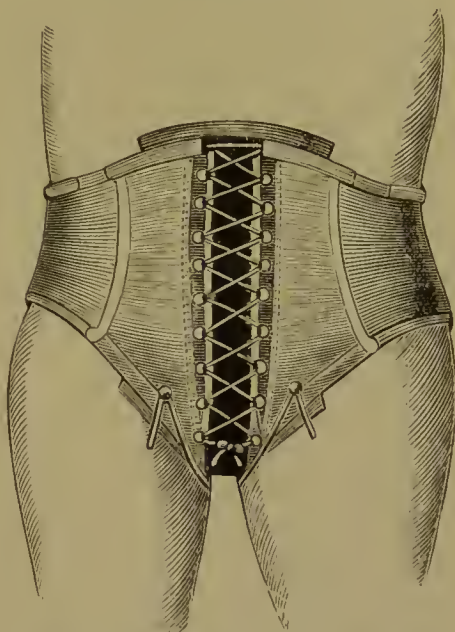
Contraindications.—*Pelvic contraction*, though sometimes considered a contraindication, is not really so unless it be too great to allow axis-traction forceps to be applied at the brim; on the contrary, moderate pelvic contraction should be one of the strongest indications for cephalic

FIG. 73.



Pinard's Abdominal Supporter, side view.

FIG. 74.



Pinard's Abdominal Supporter, front view.

version. When the pelvimetry of primiparæ is more generally practised, and physicians are able to estimate more correctly the various kinds and degrees of pelvic contraction, I believe that external cephalic version, followed by the high-forceps operation, will be generally preferred to podalic version, and will yield better results for both mother and child.

Prolapse of funis is generally a contraindication, because podalic version gives the child a better chance than cephalic version, reposition of the cord, and forceps.

Imperfect mobility of the fœtus *in utero* is the main contraindication, according to Pinard. This impaired mobility may be due to either maternal or fœtal causes—*e. g.* :

1. *Multiple Pregnancy.*—Version is possible only after the birth of the first child;

2. *Breech Presentations in Primiparæ.*—When the presenting part remains fixed and does not yield to gentle effort;

3. *Shoulder presentations* complicated with malformation of the uterus;¹

¹ Malformation of the child in rare cases prevents version or renders it very difficult. Dr. MacCallum of Montreal reports a case where hydrocephalus was the obstacle.

4. *Labor*.—The mobility of the fœtus is impaired or destroyed when the waters come away. Pinard then dreads that manipulation may produce a prolapse of the cord or extremities or a face presentation. But, on the other hand, cephalic version has been often performed successfully during the progress of labor, and I am not aware of any authentic case of prolapsed funis or of face presentation directly resulting from the performance of cephalic version during labor.

If external manipulations fail, the combined method may be tried, and if that also fails, podalic version is still available.

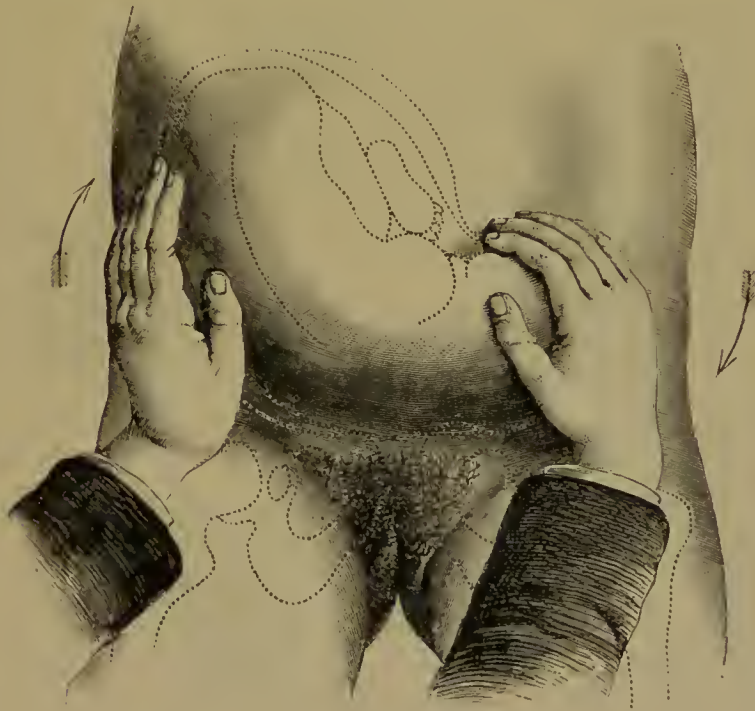
Considerable difference of opinion exists as to the proper limitations of cephalic version. In *transverse* presentations most authorities are now agreed that it should be tried when the fœtus is freely movable and undue force is not required; but in *breech* presentations the majority do not yet consider it either necessary or advisable. It is argued that in primiparæ, in whom breech presentations are hardest to manage and version would be most useful, the operation is rendered difficult, or even dangerous, by the rigidity of the uterine tissues; while in multiparæ, in whom the tissues are lax and manipulation easy, breech cases usually end favorably and version is not required. In America, at all events, external palpation will need to be more generally practised and greater manipulative skill acquired before cephalic version comes to be generally adopted in breech presentations. It is a serious defect in our obstetrical teaching that students are not more earnestly impressed with the value of external palpation and systematically trained in its use. Perhaps the fault may be due in large measure to lack of clinical facilities; but, however that may be, it is the manifest duty of our medical schools to see that their students have systematic clinical instruction in external palpation and pelvimetry. By constant practice only can a practitioner obtain that diagnostic and manipulative skill which are requisite for success in external cephalic version. What this operation is capable of doing is well shown in Pinard's wards at the Lariboisière Hospital, where, if the cases are seen in good time, abnormal presentations are diagnosed and rectified and all cases terminated as presentations of the vertex.

METHODS.—1. *Posturing*.—If the waters are not away and the head is lying somewhat to one side, place the patient upon that side with a pillow under the abdomen. For example, if the head is lying to the left, place the patient on her left side, so that the fundus and breech may fall over to the left, and in so doing may dislodge the head and tilt it over the pelvic brim. If the manœuvre is successful, turn the patient over upon the back immediately, so that the head may not glide away again, and apply an abdominal supporter to keep it fixed in the pelvic brim till the onset of active labor. In *transverse* presentations this method never succeeds, and under any circumstances it is uncertain and unreliable.

2. *External Method*.—Place the patient in the ordinary position for abdominal palpation—viz. on the back, close to the edge of the bed, with legs extended and slightly separated, and arms extended beside the body. Among the French it is customary for the operator to stand beside the patient opposite her thighs and looking up toward her head; among the Germans he usually stands opposite her waist, looking down toward her feet; but some obstetricians prefer placing the patient across the bed in the dorsal position, and standing directly in front of her between her thighs while operating. The manipulations should be performed only when the uterus is thoroughly relaxed, never during a pain.

(1) In *transverse* presentations, the head being in one iliac fossa and the breech in the opposite flank. Apply one hand over the head, the other over the breech; then by means of gentle sustained pressure exerted simultaneously try to press the breech up with one hand and draw the head down over the pelvic brim with the other (Fig. 75).

FIG. 75.

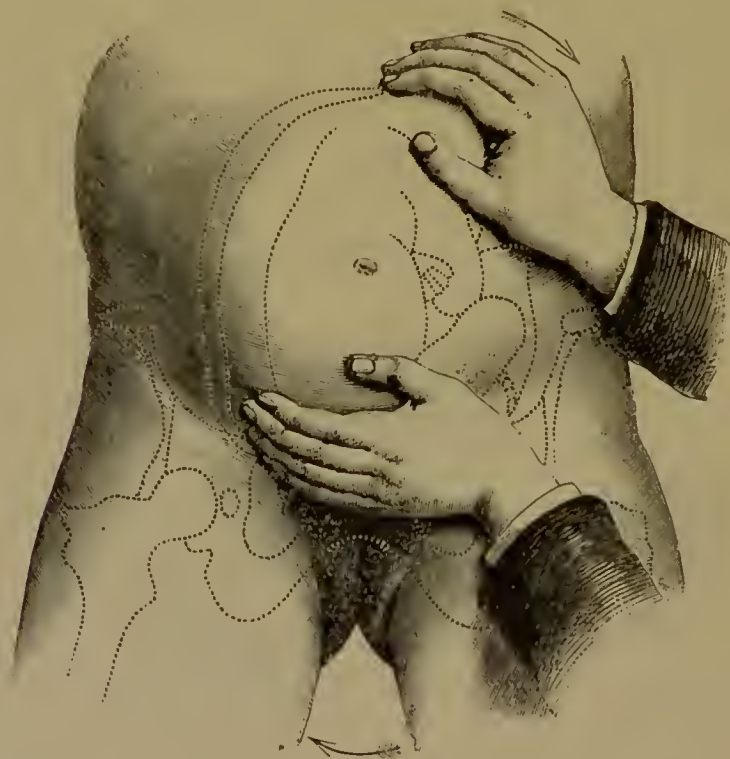


(2) In *breech* presentations, the head being in the upper uterine segment, Pinard's¹ method is as follows: (a) First make the foetus movable. In multiparæ this is easy, because both extremities of the child are usually accessible and the lax abdominal walls permit free movement of the foetus; in primiparæ, especially if near full term and if the

¹ *Traité du Palper abdominal*, pp. 185-189.

presentation be the result of true accommodation, the foetal extremities can be but partially controlled by the operator's hands. If the head is hidden under the false ribs and coils of intestine lie between the uterus and the abdominal wall, the head may be displaced and brought within reach either by pressing it down upon one side or by displacing the breech. In incomplete breech presentations, though the head may be readily accessible, the breech may sometimes press slightly into the pelvic cavity, and be incapable of manipulation. By means of a finger in the vagina the inferior uterine segment should then be lifted above the brim and the breech pushed over toward one of the iliac fossæ, while slight pressure is made in an opposite direction over the cephalic extremity. (*b*) Both foetal extremities being movable and accessible, apply the hands over them, and by slow, continuous pressure cause the breech to ascend and the head to descend by the shortest route. (See Fig. 76.) Pressure made over the *pelvic* extremity is more efficient

FIG. 76.



than that made over the *cephalic*. In the majority of cases pressure should be in the direction of flexion; occasionally however, it must be made in the opposite direction, and in such cases extension of the head need not be feared if care be taken not to press upon the cephalic extremity only. In primiparæ the operation is far more difficult than

in multipare, and the pressure needs to be more sustained and prolonged. (c) If after several attempts the fœtus cannot be made to rotate the operation should be abandoned.¹

3. *Combined Method*.—If the external method is contraindicated or has failed, the combined method should be tried. Various procedures have been recommended, most of which have now little more than historic interest.

Busch introduced the hand corresponding to the *head*, ruptured the membranes high up, and endeavored to draw the head down into the pelvis, while the external hand steadied the uterus and pushed up the breech.

D'Outrepoint introduced the hand corresponding to the *breech*, and tried to lift the presenting shoulder and push it over toward the breech, while the external hand simply steadied the uterus.

Seanzoni improved D'Outrepoint's method by making the external hand press down the head from the iliac fossa toward the pelvic inlet.

Wright of Cincinnati, like Busch, introduced the hand corresponding to the fœtal *head*, and, like D'Outrepoint, seized the presenting shoulder, but did not attempt to raise it; he pushed it laterally, so as "to give the body of the fœtus a curvilinear movement." With the external hand he dislodged the breech and moved it toward the centre of the uterine cavity. The body being thus bent upon itself, the head was gradually drawn toward the brim without any direct pressure being made upon it.

These methods all require the fœtus to be movable and the os well dilated. The methods of Hohl and Braxton Hicks are of greater practical value, because they may be used in cases where the os is only wide enough to admit two fingers.

Hohl, like Busch, introduced the hand corresponding to the fœtal *head*, passed two fingers into the cervix, and pushed the presenting shoulder over toward the breech. The external hand meanwhile pressed the head down toward the brim, while an assistant grasped the fundus with both hands and guided it toward the side where the head originally lay.

Braxton Hicks, unlike the other operators, prefers the *lateral* position. When the patient lies on her left side he introduces the left hand; when on her right side, the right hand. With two fingers of the internal hand passed up to the presenting part, like Hohl he pushes the shoulder in the direction of the breech, while with the external hand, like Seanzoni, he presses the head down toward the

¹ Cazeaux remarks that external cephalic version is not a popular operation, and assigns two reasons: (1) the inefficiency of the operation before labor; (2) the difficulty of the operation during labor. Pinard adds another reason: (3) insufficient knowledge of palpation.

brim till it is received on the tips of the fingers inside the os. It may then be directed to whatever position is desired. Sometimes the external hand is made to do double duty, alternately pressing the head toward the brim and the breech toward the fundus. No assistant is required.

II. PELVIC VERSION.—1. *Turning to the breech* is very seldom done. Occasionally, when the os is only slightly dilated and cephalic version has failed, turning to the breech may be tried. Kleinwächter says it is indicated when the pelvis lies nearer the inlet than the head does and cephalic version would be difficult or impossible. Pelvic version may be accomplished either by external manipulations or by the combined method, as in cephalic version.

2. *Podalic Version*.—Turning to the foot is a variety of pelvic version in which the feet or knees are seized and the child made to rotate *in utero* by traction upon them. The operation is safer for the child when only one foot or knee is brought down.

Indications.—There are three principal indications for podalic version :

(1) In *transverse* presentations, when cephalic version is impracticable or unadvisable, or when for some reason podalic version is safer for mother or child ;

(2) In *head* presentations if the ordinary course of labor is apt to endanger mother or child, as in placenta prævia, prolapse of the cord, deformity of the pelvis or fœtus, face presentations, etc. ;

(3) In *urgent cases* when there is no time to lose, and when delivery can be soonest effected by turning to the foot and extracting, as in eclampsia, hemorrhage, rupture of the uterus, pressure on the prolapsed cord, etc.

In the first two classes the case may be left to nature after version has been completed, but in the third class extraction must immediately follow version.

Essential Conditions.—1. The os should be dilated or dilatable, full dilatation not being necessary. Braxton Hicks' method may be employed when two fingers can be passed through the os. A soft dilatable os and unruptured membranes make the operation much easier.

2. The uterus must not be so firmly contracted upon its contents that rotation of the fœtus *in utero* is rendered difficult or dangerous. The injudicious use of ergot and early loss of the liquor amnii are the two causes which most frequently excite the uterus to mould itself to the contour of the fœtus.

3. The presenting part must not be so firmly engaged that it cannot be safely dislodged. Forceful attempts to dislodge a presenting part which has become wedged in the pelvis may quite easily cause rupture of the uterus.

4. The pelvis must not be too contracted. With a conjugate less than $2\frac{3}{4}$ inches (7 cm.) version at full term is unsafe. In oblique contraction version is admissible if it be so performed that the widest part of the head is brought into the roomiest side of the pelvis.¹ The brim of a narrow pelvis should not be so filled up with the presenting part as to prevent the introduction of the hand.

5. *An Exact Diagnosis.*—A careful external and internal examination should be made, so that the position of the child may be accurately determined and the condition of the os and the presenting part ascertained.

PROGNOSIS.—This varies greatly according to the circumstances under which the operation is performed. If under *favorable* circumstances, the prognosis for the *mother* will be good; for the *child*, not so good, especially if the patient is a primipara. If under *unfavorable* circumstances, such as contraction of pelvis, placenta prævia, or eclampsia, the prognosis will be worse for both, but particularly for the *mother*, whose danger is increased enormously by the complications as well as by the injuries produced during forcible extraction.

PRELIMINARY DETAILS.—Before operating prepare for every emergency. Make everything ready beforehand, for during extraction there will be no time to waste. Provide filets, an elastic catheter as a filet-bearer, and a pair of long forceps (axis-traction) in the event of difficulty with the after-coming head. As the child is apt to be born asphyxiated, have the proper means for resuscitation at hand, such as warm towels, blankets, hot water, high wines, etc. Empty the bladder and rectum, and, unless specially contraindicated, administer an anæsthetic, particularly if the patient is a primipara. From rigidity of the perineum or resistance at a critical moment many a child's life has been lost which might have been saved by the timely use of an anæsthetic.

Position of the Patient.—Some prefer the dorsal and others the lateral position;² some place the patient across the bed, and others at the side of it. In the lateral position it is easier to pass the internal hand up into the uterine cavity and grasp a foot or knee, but the external hand works under greater mechanical disadvantages, and cannot therefore give as much assistance as in the dorsal position. *Turning* may perhaps be easier in the lateral position, but *extraction* is certainly easier in the dorsal. Some do not place the patient across the bed unless difficulty is anticipated, but we cannot be sure in any case that

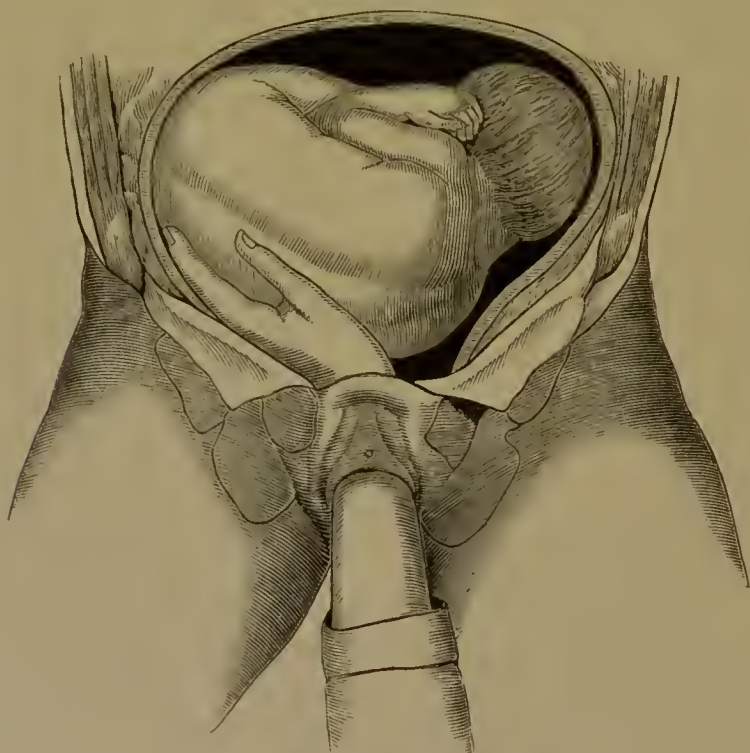
¹ Unless the pelvis is very large or the fœtus very small, the foot that is brought down always comes to the front. If the right half of the pelvis is roomiest, bring down the right foot, and the occiput will be thrown over into the right half of the pelvis. If the left half is the largest, bring down the left foot.

² Two essential points are that the vulva and perineum be quite free, so that nothing may impede the operator's movements, and that the body be so supported that the pelvic and abdominal muscles are kept relaxed.

there will be no difficulty, and a few moments' delay in the stage of extraction may be fatal to the child. It is far better in every case to be prepared for possible difficulties, and to arrange the patient so that she can be delivered easily and rapidly. Place her across the bed, with her hips close to the edge, on her side or back. If the lateral position is preferred for version, the patient can be easily turned over upon the back for extraction if necessary. If the dorsal position is to be used, a table or high bed should be prepared, for version cannot be performed with dexterity or comfort if the patient is on a low bed with spring or wire mattress.

Choice of hand is a matter of secondary importance. Some obstetricians prefer one hand, and some the other; moreover, if one hand becomes cramped and tired during the operation, it must be replaced by the other. English obstetricians place the patient on the left side and introduce the left hand. The French and Germans place the patient on the back and use the right or left hand according to circumstances. In

FIG. 77.

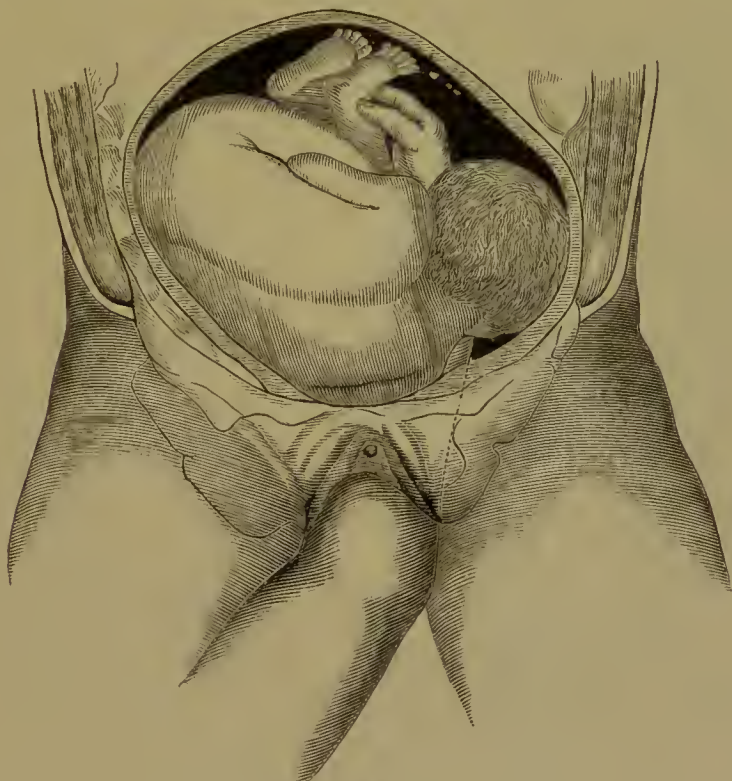


Internal Podalic Version, French method.

dorso-anterior transverse positions the French select the same hand as the presenting shoulder, while the Germans use the hand corresponding to the side on which the feet are to be found (Figs. 77 and 78). For example, if the child is lying with back to the front, head in the left

iliac fossa, feet on the right side, and right shoulder presenting, the French would use the *right* hand and the Germans the *left*. In dorso-posterior transverse presentations both French and Germans would use the same hand. The difference between the French and German methods as regards the choice of hand is explained by the fact that the French

FIG. 78.



Internal Podalic Version, German method.

pass the hand along the side, hip, and thigh of the child as a guide to the knee or foot, while the Germans pass the hand directly up to the anterior plane of the child, and thence, without any guide, toward the spot where the foot or knee is expected to be found. As a rule, the hand whose palm faces the abdomen of the child will seize the foot more readily and effect rotation more rapidly than the other. When once the operator has introduced his hand into the uterus, he should not withdraw it, if possible, till version is complete, even if it turns out to be the wrong hand theoretically; he should merely adopt the form of manipulation (French or German) for which the hand *in utero* is best suited.

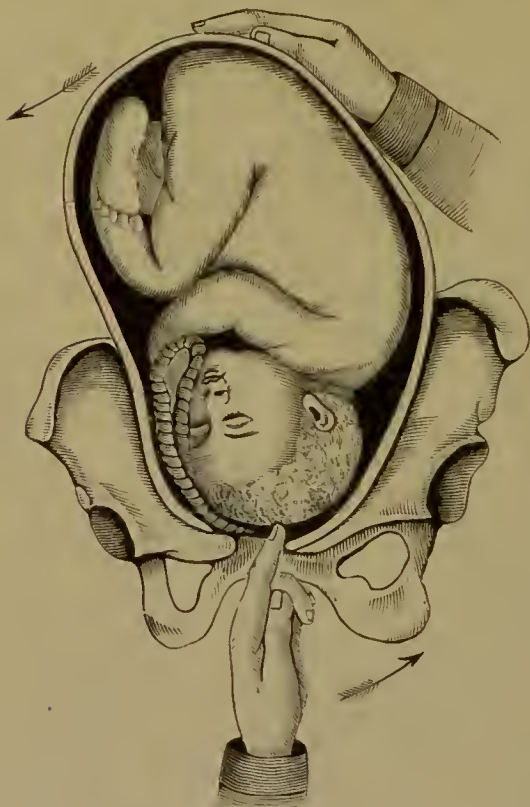
Of far greater importance than the choice of the hand is a *correct diagnosis*. If by means of external palpation the practitioner is able to make a correct diagnosis and form a mental picture of the relative position of the fetal parts and the maternal structures, he will find version a comparatively simple matter.

In the operation of turning three stages are usually described : 1, the introduction of the hand and search for the foot or knee ; 2, the rotation of the fetus *in utero* ; 3, extraction.

METHODS OF OPERATING.

1. *Combined Method of Braxton Hicks.*—After the bladder and rectum have been emptied, an antiseptic vaginal douche administered, and the operator's hands and arms thoroughly disinfected, the patient should

FIG. 79.



Braxton Hicks' Method of Combined Podalic Version, first stage: One or two fingers of the left hand lift the head from the brim and push it toward the left iliac fossa, while the right hand pushes the breech transversely toward the right side (Hicks).

the left ilium, while the right hand outside presses the breech over toward the right side (Fig. 79). As the head glides away toward the

be chloroformed and placed in the left lateral position.¹ The back of the left² hand and arm (never the palm) having been well oiled, the labia are held apart by the right hand, while the left is made cone-shaped and introduced wholly or partially into the vagina, so that two fingers may be passed up through the os till their tips touch the presenting part. In primiparæ especially this manœuvre must be performed with great gentleness and patience, pressure being made upon the perineum and not upon the symphysis and soft parts in front. If the head is presenting, it must be propelled toward the side on which the occiput lies. For example, if the vertex presents in the first position, the fingers inside the uterus gently lift the head and push it toward

¹ Where the dorsal position is preferred the right hand is usually chosen when the feet of the child are turned to the right side; the left hand, when they are turned to the left.

² In Germany, when the patient lies on the right side the left hand is used; when on the left side, the right hand.

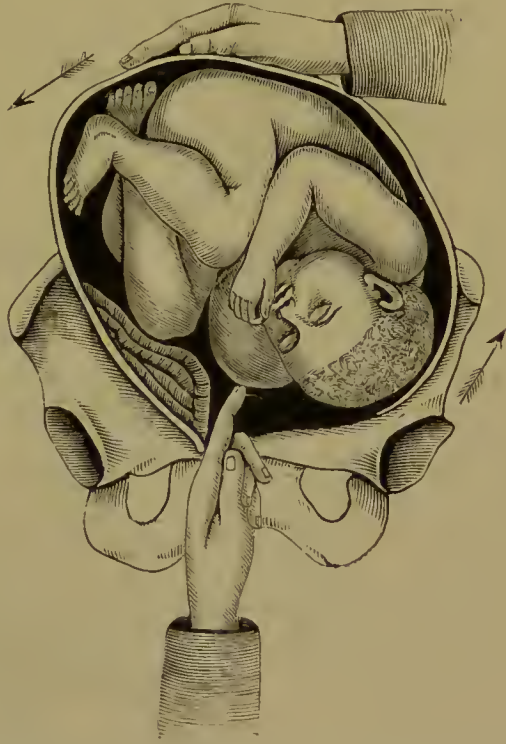
left the shoulder comes within reach, and is pushed along in a similar manner (Fig. 80). When the breech has been pressed well down into the iliac fossa, the membranes are ruptured during a pain. A knee will then be found not far from the os internum, and can be readily hooked down into the vagina (Fig. 81). The outer hand is then removed from the breech and transferred to the head. The simultaneous action of downward traction upon the leg and upward pressure upon the head readily causes rotation of the fœtus (Fig. 82). In *transverse* presentations the presenting shoulder is first gently dislodged, and then similar manipulations employed.

The combined method usually succeeds if the liquor amnii is still present or has but recently drained away and considerable fœtal mobility remains. If it fails, the whole hand must be passed into the uterine cavity and search made for a knee or foot.

2. *Internal Method.*—In

transverse presentations, the os being sufficiently dilated and the membranes unruptured, oil the hand, and in the interval of the pains pass it into the vagina. Rupture the membranes opposite the os internum, and immediately pass the hand into the uterine cavity with the palm toward the abdominal aspect of the child. Search for a foot or knee, seize it, and draw it down through the os into the vagina. Version proper is finished when the breech has been brought down so as to present at the brim. During these internal manipulations the external hand must keep the uterus under constant control, pushing it well downward to prevent overstretching of its vaginal attachments and to bring the fœtal members in the direction of the inside hand (Fig. 83). The feet are usually situated pretty high up, and the hand has often to be passed to the fundus before a foot can be seized. Difficulty in finding a foot is often due to the fact that the hand has not been introduced far enough and search has been made too low down.

FIG. 80.



Braxton Hicks' Method, second stage: The left hand pushes the shoulder to the left, while the right hand pushes the breech to the right and downward (Hicks).

FIG. 81.



Braxton Hicks' Method: The right hand forces the foetal limb down within reach of the left hand, so that the fingers may be hooked over the knee (Hicks).

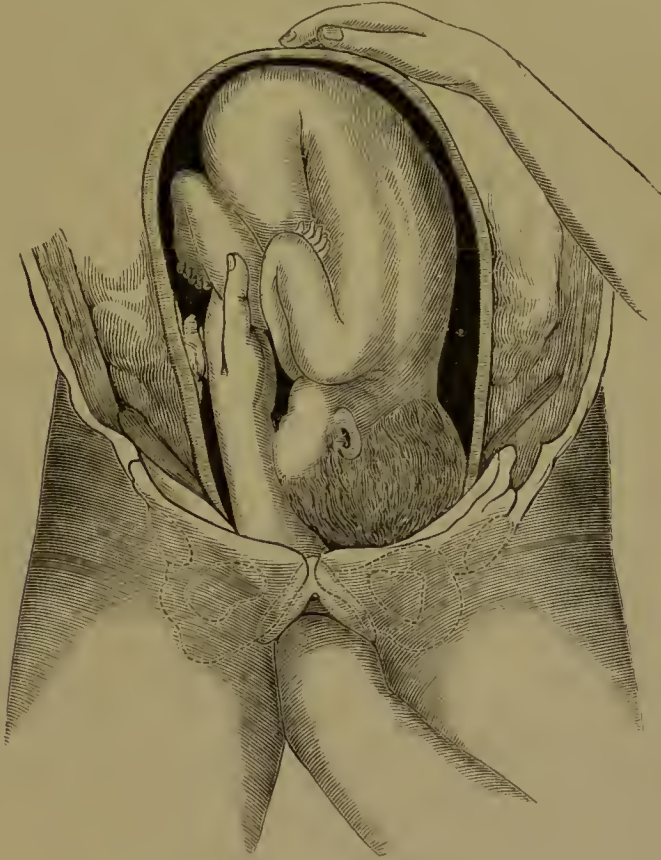
FIG. 82.



Braxton Hicks' Method, final stage: The left hand makes downward traction upon the leg, while the right hand presses the head upward. When the long axis of the child coincides with that of the uterus, the right hand makes downward pressure.

Should one foot or both be brought down? If only one, which? These questions have been long and learnedly discussed, but it is now pretty well agreed that if possible only one foot should be brought down. In primiparæ particularly, when the case is conducted as a

FIG. 83.



Podalic Version in Head Presentation.

half-breech, the soft parts are better dilated, the thorax, arms, and after-coming head are delivered more rapidly, and the child is less likely to perish during extraction than when it is dragged through structures which are rigid and only slightly dilated. In exceptional cases, when turning with one foot is difficult, both must be seized and brought down.

Which foot or knee should be selected? In *dorso-anterior* positions most authorities agree that the nearest (lowest lying) foot is the proper one to bring down. In *dorso-posterior* positions there is more difference of opinion: Tarnier, Charpentier, Depaul, Martin, Scanzoni, Lange, Schroeder, etc. advise the lower foot, while Hohl, Kristeller, Simpson, Barnes, and others prefer the upper. Barnes strongly advocates grasping the knee instead of the foot, and prefers the upper one in all cases. Scharlan and Von Haselberg, on the other hand, con-

tend that when the upper foot is drawn down it is apt to become crossed with the lower one, twisting the body so as to cause injurious pressure or make turning impossible. According to Fritsch, it is all the same which foot is grasped, because the back is directed posteriorly during version and comes to the front only during extraction. According to Pajot, the best foot to seize is the one which can be held best and most firmly.¹ Many complicated and ingenious diagrams have been drawn to show that version is always easy if done by the author's method, but difficult or impossible if done by any other. Notwithstanding the diagrams, however, version can be successfully performed in many different ways. In unsuccessful cases, no doubt, the *post-hoc propter-hoc* argument has been frequently employed, and want of success attributed to seizing the wrong foot or introducing the wrong hand, rather than to its rightful cause. Traction is sometimes made too far forward, and then the free foot is apt to be thrown across the symphysis, preventing further descent. The anterior hip and foot are the ones which usually give trouble. If rotation does not take place when traction is made upon the foot or knee which has been brought down, the other one must be found and drawn down also. Before commencing the search for the second foot a noose should be slipped over the first one to keep it under control. If it is found difficult to grasp the second foot firmly enough to make traction upon it, a noose should be slipped over it also. The application of a sling is not always such a simple matter as might be supposed. When the foot is at the vulva or in the anterior portion of the vagina it is easy enough to pass the filet over the ankle, but when the foot remains in the upper part of the vagina it is sometimes a very difficult matter, and one of the following methods must then be adopted: With a piece of broad strong tape a running loop is made and slipped over the left wrist; the left hand is passed into the vagina, seizes the foot, and draws it down as far as possible; the loop is then pushed up over the left hand by the fingers of the right till it surrounds the child's ankle completely; the ends of the loop are then tightened and a firm hold is obtained. When the vagina is not large enough to allow the fingers of the right hand to execute this manœuvre, the loop must be carried up by means of a repositor: Braun's is the simplest and best, consisting of a flexible rod sixteen or eighteen inches long, with an eye two inches from its upper end. The running loop is prepared and slipped over the left wrist as described above: it is then secured to the repositor in the manner shown in Fig. 84 and carried up to the desired position. An ordinary gum-elastic male catheter would serve the purpose quite as well: it may be used without a stilette, as in Figs. 85, 86, or with it, as in Figs. 87, 88. A long pair of dressing,

¹ "Le pied qui est le bon, est celui qui l'on tient le mieux et le plus solidement."

uterine, or polypus forceps occasionally succeeds when other means fail.

If the second foot is beyond reach, or if traction upon both limbs does not cause the fœtus to rotate, an attempt should be made to dislodge the impacted shoulder. Crutches and various other mechanical appliances have been devised from time to time to aid in accomplishing this result, but the hand is safer and better than any of them. In these cases Goodell recommends bringing down the upper arm and ro-

FIG. 84.

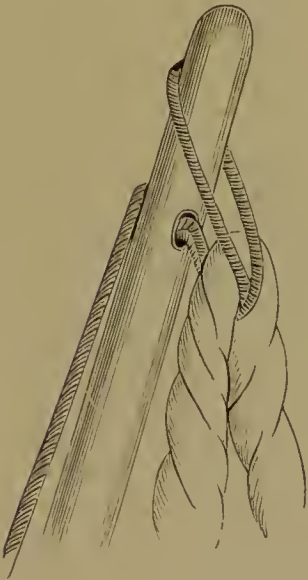


FIG. 85.

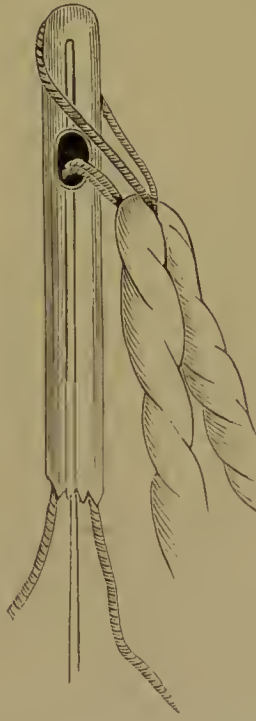


FIG. 86.



FIG. 84.—Braun's Repositor, arranged as a noose-carrier.

FIG. 85.—Male Gum-elastic Catheter, used as a Braun's repositor.

FIG. 86.—Another Way of Using a Male Catheter as a Noose-carrier.

tating the child on its long axis, or else introducing into the vagina the hand corresponding to the child's head, and gently pushing the presenting part away from the cervix. The longer the waters have drained away, the more difficult it becomes to turn and the more liable is the uterus to rupture. If rupture is feared, the patient should be kept well under an anæsthetic and manipulation practised with the utmost gentleness and patience. The external hand is of great service in steadying and supporting the uterus during the operation and aiding in the descent of the breech. If gentle manipulations fail to accomplish version, it is safer to desist from further attempts and resort at once to embryotomy or decapitation.

In *cephalic presentations* the operation is practically the same as in transverse. After a foot or knee has been seized, it sometimes happens that rotation is prevented by the head remaining in the pelvic brim. If not too firmly wedged it may be dislodged by the thumb pushing up the head, while the index and middle fingers pull down the foot, or a sling may be passed around the ankle and traction made upon it while the hand endeavors to push back the head. If one foot can be brought down only partially, and version cannot be completed till the other is secured, a noose should be applied above the ankle of the first foot and entrusted to an assistant while search is being made for the second foot. If the feet have become displaced they may be readily

FIG. 87.

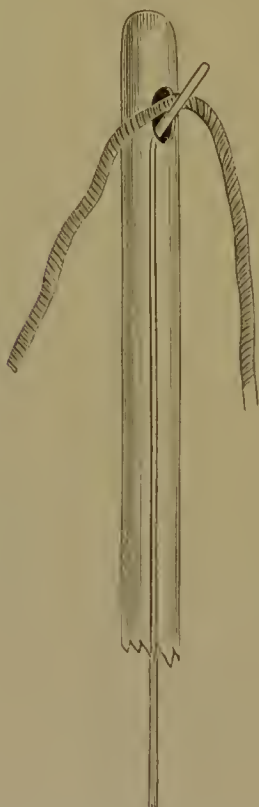


FIG. 88.

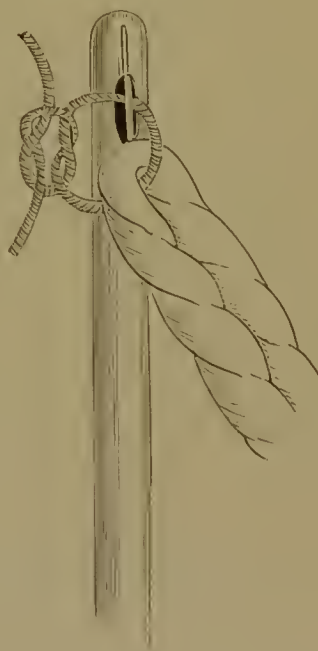


FIG. 87.—German Method of Using a Male Gum-elastic Catheter as a Noose-carrier: the stilette is made to protrude from the eye, and a small cord slipped over it.

FIG. 88.—The Stilette, pushed home, holds the cord: when the noose is to be set free the stilette is withdrawn.

found by passing the hand along the child's back and thighs as a guide. If they lie anteriorly above the hypogastrium, the symphysis will prevent their being reached by the hand as long as the patient is in the dorsal position; but in the lateral or knee-elbow position there will be no difficulty.

During the first stage of labor, while dilatation of the os is still going on, version may be performed easily at any time; but when dilatation is complete and the expulsive stage has begun, the liquor amnii

may come away suddenly at any moment, and the uterus contract about the fœtus so as to make version difficult or dangerous. While it may be well to refrain from operating during the stage of dilatation, it is bad practice to delay when the expulsive stage has once begun. Winter strongly recommends waiting till the os is dilated or dilatable, so that version may be immediately followed by extraction. He claims that the child's chances will be improved thereby, because there will be less risk of—(1) the cord being injured or compressed; (2) air entering the uterus, causing tympanitis uteri, which is fatal to the child; (3) premature separation of the placenta. In transverse presentations version should be performed as soon as the os is soft and dilatable, for it must be remembered that in such cases full dilatation of the os does not usually take place, especially if the waters have come away.

Should extraction immediately follow version?

From an analysis of 310 uncomplicated cases of transverse presentation which occurred in the Berlin Clinic between 1876 and 1884, Winter¹ concluded—(1) that version should not be performed till the os is sufficiently dilated to permit of extraction; (2) that the best results for the child are secured when extraction immediately follows version. Dohrn² of Königsberg accepts the first of Winter's propositions, but not the second, and contends that the interests of mother and child are best secured by the spontaneous expulsion of the fœtus, and that extraction should be performed only for definite indications. He says that when extraction immediately follows version the position and rotation of the fœtus are apt to be different from what they would have been in spontaneous delivery, and claims that the natural coaptation of the fœtus to the parturient canal is less dangerous than the artificial. In 152 cases in his clinic in which extraction immediately followed version 22 children were lost, while in 29 cases delivered spontaneously after version there was not a single fœtal death. Upon the whole, continental opinion so far seems to side with Winter and Schroeder, and the teachings of the Berlin School guide practice in this respect.

SOME DIFFICULTIES AND DANGERS.

Capping of the Fundus.—Turning is both difficult and dangerous when with strong uterine action there is hindrance to the passage of the child, such as a transverse position or contraction of the pelvis. The muscular corpus, unable to overcome the hindrance, contracts and pulls itself up till nearly the whole body of the child is left enveloped in the stretched and thinned lower segment and cervix. Rupture of the uterine

¹ *Zeitschrift f. Geburtshülfe und Gyn.*, Bd. xii.

² *Ibid.*, Bd. xiv. S. 72.

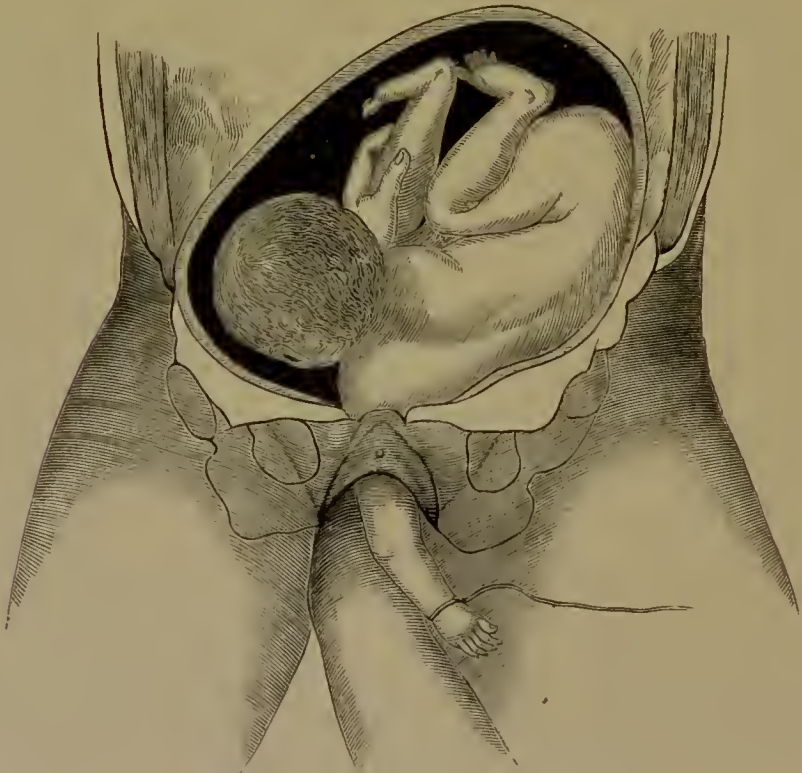
is then very liable to occur, especially if attempts be made to perform version.

Tetanus uteri, as it is sometimes called, is occasionally produced by the injudicious and untimely use of ergot. The uterus is in a state of tonic contraction, and grasps the child so tightly that the hand cannot be passed up to reach a foot or knee. At one time bleeding was the favorite means of relaxing the uterine muscle; hot baths and opium were sometimes employed for the same purpose; but at the present time chloroform and gentle continuous pressure are preferred. The patient being first deeply narcotized, the hand is pressed carefully past the presenting part, and the tetanic contraction of the uterus gradually overcome by patient manipulation. In most cases version can then be performed.

Edema of the vulva is sometimes a serious impediment, and if undue pressure be made upon the soft parts gangrene may result.

Obstructions in the cervix, such as undue rigidity, incomplete dilatation, spasmodic contraction, placenta prævia, etc., may render version

FIG. 89.



Podalic Version when an Arm is Prolapsed.

difficult. The means usually recommended for the relief of such conditions are the inhalation of chloroform, opium, or alcohol internally, hot baths and douches, the application of cocaine solutions to the cer-

vix, a weak faradic current, dilatation manually or by rubber bags, and, as a last resort, multiple incisions of the external os.

Prolapse of the arm in transverse positions used to be considered a serious impediment to version, and many ingenious manœuvres were suggested to reduce it.¹ Louise Bourgeois (1609) dipped the arm in

FIG. 90.



Method of Lifting an Impacted Shoulder from the Brim: The right hand lifts the shoulder, while the left pulls down the leg by means of a sling (Barnes).

cold water to make the child draw it back again into the uterus, or greased it well with melted butter and tried to push it back. When the arm was livid and swollen and could not be replaced, some obstetricians did not hesitate to amputate it. Nowadays prolapse of the arm is not considered a disadvantage; indeed, it is sometimes of use in enabling the attendant to arrive at a correct diagnosis of the child's position in utero.²

¹ Saint-Germain advised putting ice in the child's hand. Deventer speaks of pinching and filliping it, so that the child might be made to draw its arm back. Albncasis, Burton, and others invented crutches, forks, and repositors to push it back, and in the event of failure pulled the arm off. Philmenes disarticulated it. Actius said it should be cut, torn, or twisted off. Guillemeau drew it down as far as possible, and then amputated it. Manricean advised twisting it, as one would the branch of a tree which he wished to extract from the ground. Josephi used to scarify the swollen part deeply, so as to reduce its bulk.

² When the waters are away, and there is any doubt about the diagnosis of the

Deventer (1701) was the first to show that reposition of the prolapsed arm is unnecessary, while De la Motte (1721), Levret (1749), Puzos (1753), and others proved it to be inexpedient as well as unnecessary. When the arm is prolapsed a noose of tape should be fastened to the wrist and held moderately tight by an assistant while version and extraction are being performed (Fig. 89). The tape enables the arm to be drawn out of the way of the operator's hand, and prevented from rising beside the child's head and complicating extraction. The swelling and lividity of the prolapsed arm are no index of the child's condition as to whether it is living or not.

Impaction of shoulder is a very serious complication. Version may sometimes be effected by a sort of bipolar manœuvre. A noose having been fastened to the child's ankle, the impacted shoulder is pushed up with one hand, while the leg is drawn down with the other (Fig. 90). Traction should not be made upon the leg till the shoulder has been somewhat lifted from the brim. Decapitation or embryotomy may be the only means of effecting delivery if the shoulder has been long impacted and the uterus has become moulded to the contour of the fœtus.

EXTRACTION.

Anæsthesia.—Opinions differ as to the value of anæsthetics during the stage of extraction. Some object that they weaken the pains and prevent the patient from rendering intelligent assistance. Others claim that such disadvantages are more than counterbalanced by the increased relaxation of the soft parts and the ease with which the hand can be passed into the vagina to perform the needful manipulations. It is maintained, moreover, that an intelligent assistant, making firm pressure upon the fundus, can apply an amount of *vis a tergo* not to be expected from the voluntary efforts of the patient herself.¹

In easy cases an anæsthetic is seldom required, but when there is much difficulty or delay deep anæsthesia is found to facilitate extraction and diminish the risks of both mother and child. The anæsthetic need not be given till it is time to liberate the arms and deliver the after-coming head.

Position of Patient.—In version proper the lateral position is often better than the dorsal; but in extraction the dorsal is usually preferable. The patient is placed on her back across the bed, with hips raised on a pillow and brought well over the edge of the bed (or open-child's position, Murphy recommends bringing the hand outside the vulva. It can then be readily seen whether the hand is right or left, and when supinated its palm will correspond to the child's abdomen (*Murphy's Lectures*, 2d ed., p. 391).

¹ Delivery of the after-coming head by means of *expression* was the routine treatment from the time of Celsus (B.C. 30) down to that of Puzos (1573), when the so-called *Prague* method was first described.

rating-table). The knees are held by two assistants, one of whom has been instructed how to support the fundus during extraction and make firm downward pressure when required. Another assistant administers the anæsthetic.

Method of Extraction.—For the sake of convenience three stages are usually described: 1. Extraction of the trunk as far as the shoulder-blades; 2. Liberation of the arms; 3. Delivery of the after-coming head.

1. *Extraction of the Trunk as far as the Shoulder-blades.*—The foot¹ which has been brought down into the vagina during version is seized by the right hand and traction² made in the axis of the brim. The limb which is pulled upon always turns in the direction of least resistance—*i. e.* to the front. As the leg emerges from the vulva it is wrapped in a warm napkin and grasped as high as possible, the thumb being directed upward and applied to its dorsal aspect. Traction is continued in the axis of the brim till the breech comes down upon the pelvic floor and begins to press upon the perineum; traction should then be directed more forward and upward. As the breech emerges from the vulva one or two fingers of the left hand may be hooked into the groin to give greater tractile power and at the same time lessen the strain upon the leg.³

When the legs have cleared the vulva, either the pelvis may be grasped by both hands or the legs may be held by one hand and the pelvis by the other. Traction is again directed backward in the axis of the brim. When the cord comes in sight it is drawn down⁴ and placed where it will be least likely to suffer injury⁵ or compression.⁶

¹ If both feet have been brought down during version, they should both be grasped by the right hand, the middle finger being inserted between them.

² Barnes insists that only *traction* should be used, and that all attempts at artificial *rotation* should be avoided. He directs the limb to be held loosely, so that it may rotate along with the trunk, and not in any way obstruct normal rotation.

³ Dr. Matthews Duncan has proved by experiment that either leg is stronger than the neck, and can bear a stronger pull. Any tractile force that is safe for the neck is safe for the leg (*Mechanism of Natural and Morbid Parturition*).

⁴ It should always be drawn down from the placental side, never from the foetal.

⁵ It occasionally happens that the child bestrides the cord; if possible, the cord should then be drawn down and slipped over the posterior thigh. If this cannot be done, it should be tied in two places and cut between the ligatures, and the child delivered as soon as possible. Time may be saved by applying a couple of Péan's forceps instead of the ligatures. Occasionally the cord is so short that it has to be ligatured and cut before labor can be terminated.

⁶ Wigand, Ritgen, and others say that pressure upon the cord affects the veins more than the arteries, and that consequently the *ingress* of blood is more impeded than the *egress*; pressure therefore tends to produce anaemia, which if prolonged may prove fatal. It is recommended to ligature and cut the cord as soon as it can be reached; and Ritgen says that there is then little need to hurry extraction. It is now, however, pretty generally admitted that in such cases *asphyria* is the cause of foetal death, and not *anæmia*: Ritgen's advice is therefore misleading.

Up to this stage extraetion has not been hurried, in order that the soft parts might have time to dilate; but now every moment is precious, and delivery must be completed as rapidly as possible.¹ The assistant henceforth maintains firm pressure upon the fundus to keep the uterus well contracted about the foetal head and shoulders. Thereby hemorrhage is avoided, and the arms are kept so closely applied to the body that they cannot be displaceed and pushed up over the head. During this stage, unless rapid extraetion is specially indicated, traetion should not be made in the interval of the pains, for fear of displacing the arms upward.

2. *Liberation of the Arms.*—As soon as the shoulder-blades begin to appear traetion is discontinued and the arms liberated. Normally,

FIG 91.



Method of Liberating the Posterior Arm when both arms have become extended beside the head (Barnes).

they are flexed and folded across the breast, but by undue or ill-timed traetion, or by neglect to support the fundus, they may be displaced above or beside the head. When in their normal position the liberation of the arms is easy, but when they are displaceed upward it may be very

¹ Before the delivery of the breech and legs the placental circulation is unimpaired and delay does not harm the foetus; but after their delivery the bulk of the uterus is so much reduced that the placental circulation is disturbed and inspiratory efforts are apt to be made. Fluids and other foreign bodies may thereby be drawn down into the respiratory passages, causing either fatal asphyxia at once or fatal inflammatory mischief in a few hours or days.

difficult. The posterior arm is generally easier to reach than the anterior, and is therefore usually brought down first. To accomplish this the body of the child is carried well up to the front around the symphysis pubis; the posterior shoulder is thereby brought within reach and more room afforded for manipulation. Two fingers are passed along the side and back of the child up over its posterior shoulder, till they can be hooked over the humerus; the arm is then easily carried with them across the face and the forearm drawn down over the breast (Fig. 91). If this manœuvre fails, the operator may withdraw his hand, and, passing the other one along the child's abdomen, attempt to bend the posterior elbow toward the anterior pelvic wall. The posterior arm having been delivered, the child's body is carried well back over the perineum and the anterior arm released by a similar manœuvre (Fig. 92). If there is not room enough to deliver the anterior arm beneath the symphysis, the liberated arm should be seized and drawn

FIG. 92.



Method of Liberating the Anterior Arm (Barnes).

up toward the symphysis: the anterior arm will then probably rotate backward into the hollow of the sacrum. If the child's back points to the left, the free arm should be raised along the left labium; if to the right, along the right. The second arm may be then delivered in the same way as the first.

The following manœuvre sometimes succeeds when others fail : grasp the child's body above the hips and rotate it upon its long axis till the back is brought a little to the left ; the *pubic* arm, not being able to follow the rotation of the trunk, is thrown somewhat across the chest, where it can be more easily reached ; then rotate the body as much in the opposite direction in order to bring the *sacral* arm within reach : only gentle manipulation is permissible ; violent rotation may twist the child's neck. Occasionally the anterior arm is displaced backward (*nuchal* or *dorsal* displacement) and the forearm thrown across the neck ; if traction is now made the displaced arm is jammed between the occiput and symphysis pubis. This very awkward complication is usually the result of improper manipulation. If possible, the posterior arm should first be released, and an attempt then made to rotate the anterior arm into the hollow of the sacrum. If the posterior arm cannot be released, the body should be carried well back over the perineum and an attempt made to pass a fore finger between the symphysis and the child's shoulder so as to draw the elbow downward and forward. If all manipulative efforts fail, the axis-traction forceps should be applied and delivery effected even at the risk of fracturing the humerus.¹ If forceps fail, craniotomy must be performed.

The shoulders usually enter the pelvis in the oblique diameter already traversed by the hips ; occasionally, however, they enter in the transverse. In such event, if the arms remain flexed and in their normal situation, they are easily liberated ; but if allowed to extend, the trunk should be rotated so as to throw one arm back into the hollow of the sacrum, where it can be more easily seized and brought down.

3. *Extraction of the Head*.—After delivery of the arms, if the fundus has been properly supported, the head will be found to have entered the pelvis in a position moderately flexed or straight, rarely extended. Extraction of the head may be effected *manually* or by *forceps* ; in the great majority of cases the manual method is quite sufficient, and is therefore to be preferred.

(1) *Smellie's Method*.—The child's body having been wrapped in a warm napkin and supported upon the palmar aspect of the left arm, the index and middle fingers of one hand are passed into the vagina and applied one on each side of the nose ; the fingers of the other hand press the occiput upward. As the head flexes traction is made and the trunk raised (Fig. 93). This method aims to produce flexion of the head upon the trunk by traction upon the superior maxilla and pressure upon the occiput applied alternately or simultaneously. It is applicable

¹ If fracture occurs, the ends of the bone should be approximated, and a short anterior and long posterior pad bandaged to the arm. Better union will be obtained if the arm is bandaged to the body. The friends should always be informed beforehand that fracture is apt to occur.

only to easy cases, where there is no disproportion between the pelvis and foetal head. In difficult cases no time should be wasted with this method.

(2) The *Smellie-Veit Method*, called also *Mauriceau's*, *Levret's*, or *Veit's*¹ method, consists of combined traction upon chin and shoulders.

FIG. 93.



Manual Extraction of the After-coming Head, Smellie's method.

If Smellie's method has been tried without success, the fingers are removed from beside the child's nose and passed into its mouth,² while those of the other hand are slipped down and hooked over the shoulders (Fig. 94). Downward traction is then made with both hands, care being taken to pull mostly upon the shoulders, so as to avoid injuring the jaw. As the head descends the trunk is raised; the occiput is pressed upward by the resistance of the symphysis, and the face, rotating

¹ Mauriceau described this method in 1668; he was the first to recommend the fingers to be passed into the child's mouth and downward traction made on the lower jaw. His method was modified by Smellie and Levret, and used by them in preference to all others. By Schroeder it was called "the Smellie-Veit Method," and in Germany it is now called by many "Veit's Method," because Veit's writings have been mainly instrumental in reinstating this mode of manual extraction. Formerly, in nearly all difficult cases the forceps was used in Germany to extract the after-coming head, but now it is seldom employed except where pelvic contraction is considerable.

² If much resistance is offered to the descent of the head through the brim, it may be found difficult or impossible to flex the head upon the trunk by means of the *Smellie-Veit* method; for when traction is made the chin can be pulled down upon the chest, but the head fastened in the brim refuses to follow. In such a case it would be better to combine the two methods: first secure good flexion by the *Smellie* method, and then deliver by the *Smellie-Veit*. If the head tends to extend during extraction, the fingers had better be kept applied to the upper part of the face, and not introduced into the mouth at all.

downward over the sacral hollow, emerges from the vulva. This method is safer and surer than *Smellie's*, the combined action of the two hands tending to prevent injurious twisting of the trunk upon the head.

When the head enters the pelvis in the transverse diameter, traction usually makes the occiput turn toward the front; but occasionally this

FIG. 94.



Manual Extraction of the After-coming Head: combined traction upon mouth and shoulders. Veit's method.

does not happen, and the occiput rotates to the sacrum, while the forehead comes down against the symphysis. The margin of the perineum becomes then the fulcrum instead of the symphysis, and downward traction makes the neck pivot upon the perineal border, while the forehead sweeps out under the pubes.

If the head is arrested at the brim, the extraction is far more difficult and the life of the child placed in greater peril: much, then, depends upon the intelligent help of the assistant in charge of the fundus.¹ A strong *vis a tergo* facilitates extraction and allows the operator free use of his hands to direct the passage of the head through the pelvis. Time should not be wasted with *Smellie's* method, but the *Smellie-Veit* should be tried at once. In most cases it will succeed, but if it fails the *Prague manœuvre* should be tried.

(3) *Prague Method*.²—The fingers of the left hand being hooked over the nape of the neck, the right hand grasps the child's feet, and the

¹ In making pressure upon the fundus force should not be applied equally over the entire head, but should be concentrated more upon the forehead, in order to push it down into the cavity and promote flexion.

² This method was fully described by Puzos (1573), and put forward by him to replace the old classic method of delivery by expression. It did not come into general use till resuscitated by Kiwisch in 1846. Unimportant modifications were suggested by Braun (1857) and Scanzoni (1864).

body is swept as far back as possible over the perineum ; traction is then made vertically downward with both hands, care being taken

FIG. 95.



Manual Extraction of the After-coming Head. Prague method.

meanwhile to maintain pressure upon the fundus. As the head slips down into the pelvis, the feet are rapidly raised toward the mother's

FIG. 96.



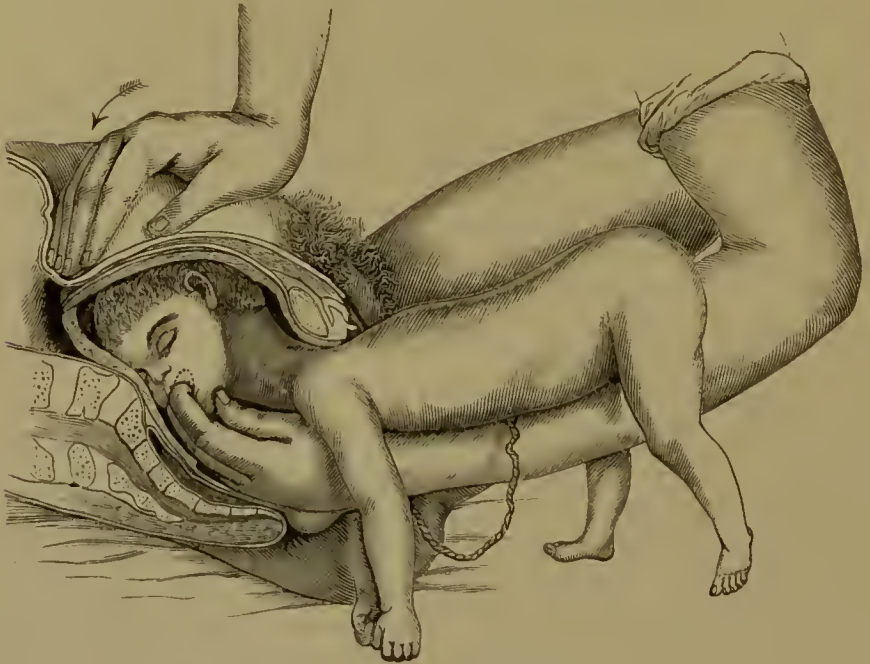
Method of Extraction when the Chin is Arrested at the Symphysis (Chailly-Honoré).

abdomen, the neck pivots upon the fingers of the left hand, and the head is shelled out of the pelvis (Fig. 95).

If the head is extended, the chin pointing forward and arrested at the symphysis, while the occiput lies in the hollow of the sacrum, the body of the child should be carried upward during traction and the occiput made to rotate over the perineum (Fig. 96).

(4) *Wigand-Martin¹ Method*.—This method consists of combined extraction and expression. The hand whose palmar surface, when midway between pronation and supination, corresponds to the abdominal surface of the child is passed into the vagina along the posterior wall until the tips of the first and second fingers reach and are inserted into the child's mouth; a firm hold is taken on the lower jaw, by which the head can be flexed and drawn down. The other hand seizes the

FIG. 97.



Wigand-Martin Method (Winckel).

occiput through the abdominal walls and exerts powerful pressure in the direction of the axis of the superior strait. By this method, Winckel says, "one can bring the head of a full developed child through a conjugate diameter of only 6 cm. in the short space of 15–75 seconds." "For this reason," continues Winckel, "the method will surely in a short time displace all others."

(5) *Forceps*.—Manual extraction having failed, the forceps should be tried as a last resort. Considerable difference of opinion exists as to the utility of the forceps in the delivery of the after-coming head. Advocated strongly by such men as Smellie, Busch, Rigby, and Meigs,

¹ See Wigand, *Beitrage zur theor. und prakt. Geburtshülfe*, Heft 2, Hamburg, 1800; Mme. Lachapelle, *Pratique des Accouchemens*, Paris, 1821, t. i. pp. 337, 338; K. Ruge, *Zeitsch. f. Geburtsh. u. Frauenkr.*, v. E. Martin, i. p. 82, 1876; Champetier de Ribes, *Du passage de la tête fœtale à travers le détroit supérieur rétréci du bassin*, 1879; A. Martin, *Berl. klin. Wochenschrift*, 1886, p. 660; Winckel, *Verhandl. des II. Gynäk. Congress*, Halle, 1888, and *Lehrbuch der Geburtshülfe*, Leipzig, 1889, pp. 683–686.

and in later times by Barnes, Cazeaux, Tarnier, Charpentier, and others, the forceps operation is opposed with equal vehemence by an influential section of the German school. Schroeder used to say that the introduction of the forceps has cost many children their lives and brought discredit upon podalic version. Whatever difference of opinion may exist as to its value in ordinary breech cases, this instrument is undoubtedly of service after version in some cases of contracted pelvis. I am sure that I have seen children safely delivered by means of forceps who would otherwise have perished, and I am equally sure that I have seen children allowed to asphyxiate who might have been saved by a timely use of the forceps. Some form of axis-traction forceps should be employed: the best models are those of Tarnier, Breus, and Poullet. Forceps will be found most useful when the head is arrested at the brim, owing to disproportion between the pelvis and foetal head. The long diameter of the head usually corresponds to the transverse of the brim; if the blades are applied in the roomiest part of the pelvis, they will grasp the head in its long diameter¹ and easily draw it down into the cavity. Some recommend applying the blades to the sides of the child's head, so that the biparietal diameter may lie in the grasp of the instrument; but the conjugate of the brim is already too narrow to permit the easy passage of the biparietal, and if this latter diameter is still further increased by the width of the forceps-blades, its passage will be rendered still more difficult.² The forceps saves the child from the dangers of too great rotation of the head upon the trunk and undue dragging upon the spinal column. It should usually be applied to the abdominal aspect of the child. If the occiput lies anteriorly, the body is drawn well up over the pubes to give sufficient room for the application of the blades (Fig. 98). If the occiput lies posteriorly, the head may be found either flexed or extended. If flexed, the body is carried down over the perineum and the forceps introduced under the symphysis (Fig. 99); traction is made downward and backward, to increase flexion and deliver the occiput posteriorly over the perineum. If the head is extended and the chin behind the symphysis, the forceps may be applied either along the child's *abdominal* or *dorsal* aspect (whichever can be done most easily), and the head made to pivot upon the submental region. Some recommend removing the forceps when

¹ Practically, the blades do not grasp the head exactly in its antero-posterior diameter, but in an oblique direction intermediate between the antero-posterior and transverse.

² It is argued by the advocates of this plan that lateral compression is more apt to overcome disproportion by increasing the antero-posterior measurements at the expense of the lateral, and that compression antero-posteriorly is apt to increase the disproportion by bulging out the head laterally. Though theoretically plausible, practically this view is incorrect; for experiments have abundantly shown that when the forceps-blades are applied at the sides of the pelvis (where there is most room), the head is moulded upward in the direction of least resistance, and not laterally, where it encounters the resistance of a narrow conjugate.

the head has been brought down into the cavity, and completing delivery by the manual method. There is nothing to be gained by so doing,

FIG. 98.



Forceps Delivery of the After-coming Head in dorso-anterior positions.

but, on the contrary, valuable time may be lost : it is better, therefore, to complete delivery by means of the forceps.

When the head is prevented from descending by stricture of the os or cervix or contraction of the cervix around the child's neck, the forceps will be found particularly useful. It rapidly dilates the constricted

FIG. 99.



Forceps Delivery of the After-coming Head in dorso-posterior positions.

cervix and delivers the head with comparatively little force, whereas when the manual method is employed traction upon the child's body

serves only to drag the uterus down toward the vulva. Whichever method is adopted, laceration of the cervix is apt to occur; it is advisable, therefore, to examine carefully after the placenta has come away, and if deep laceration exists to apply silk or worm-gut sutures. Chloroform is essential in such cases. Depaul recommends dilatation of the cervix by the fingers before delivery is attempted, and if that fails incision of the cervix.

Time is the great element in safe delivery after the cord has come into view. If the head is not delivered within four to eight minutes, the child will probably be stillborn or else deeply asphyxiated.¹ Exceptionally, children have survived fixation for fifteen minutes. If the child breathes, foreign bodies are apt to be drawn down into the air-passages, causing asphyxia at once or lobular pneumonia in a day or two. Attempts have been made to obviate asphyxia by trying to supply the child with air artificially. Pugh recommended passing two fingers into the mouth and allowing air to enter along the hollow of the hand. Weidmann conveyed air into the mouth by means of a catheter or special tube prepared for the purpose (*vectis ærophorus*).

In difficult cases there is no time to waste, for the child should be delivered in four or at most five minutes after the liberation of the arms. It is well to adopt in all such cases a certain routine, and have each stage of the operation accurately timed, since it is very difficult for an operator in his hurry and anxiety to gauge correctly the lapse of time. Not only should all instruments be prepared beforehand and placed within easy reach, but whenever possible the plan of operation should be explained to the assistants and minute instructions given them as to what they are expected to do. Coolness and presence of mind on the part of the operator beget confidence in the assistants and secure prompter service. When manual extraction is to be tried in a difficult case the Smellie-Veit or Wigand-Martin method should first be practised; if that fails, the Prague method. In the great majority of cases one or other of these will succeed; but if steady manipulation for two, or at most three, minutes fails to deliver the head, no more time should be wasted: the forceps should be applied without delay. It is not then a question as to whether manipulative efforts might not after a time succeed in delivering the head, but whether they will succeed soon enough to save the child. Forceps sometimes fails to save the child's life because its application is deferred too long; the child has already

¹ Hodge pointed out that asphyxia caused by the separation of the placenta from the uterus before the delivery of the child's head is a more frequent cause of foetal death in breech cases than pressure upon the cord. He says: "This seems to me by far the most frequent reason why children so often perish in pelvic deliveries, and why so little confidence should be placed in attempting to remove the cord from pressure" (*Am. Journ. of Obstet.*, May, 1875).

become asphyxiated during long-continued and fruitless manipulative efforts; the want of success cannot then be fairly attributed to the forceps.

VERSION VS. FORCEPS.

For ages, version was the only conservative means of terminating labor artificially, but after the invention of the forceps its sphere became greatly circumscribed. Since the principle of axis traction has been carefully worked out, and the mechanical construction of the forceps improved, it has become possible to deliver the head presenting at the brim with comparatively little risk. The perfecting of the high-forceps operation has given an impulse to external cephalic version, so that in many cases where formerly podalic version would have been performed external cephalic version is now practised, and labor terminated by the high-forceps operation. In Germany version is still the favorite operation, but in France the axis-traction forceps has greatly circumscribed its domain. In England and America deformity of the pelvis is far less common than on the Continent, and dystocia is more frequently due to impediments at the outlet than at the brim. Placenta previa, also very common in Central Europe, is comparatively infrequent on this continent. Hence, except among the immigrant population, version is comparatively rare, while forceps are used so frequently that America has been aptly styled the home of the low-forceps operation.

As a general rule, when the child is of moderate size, the forceps should not be used

in the *simple flat* pelvis with a conjugate of 3 in. (7.6 cm.) or under,¹

“ *generally contracted* 3½ in. (8.2 cm.).

The nearer the conjugate approaches to these limits the more dangerous the forceps operation becomes, and the more clearly is version indicated. A conjugate of 2¾ in. (7 cm.) may be considered the lowest limit of version.

Except in cases of considerable pelvic contraction the forceps operation may be regarded as comparatively harmless in skilled hands, while internal version is always a serious undertaking, involving more or less danger for mother and child even when performed with the greatest skill. The unpractised operator is far less likely to do harm with the forceps than with version. Whenever, then, it comes to be a question of choosing between forceps and internal version, the forceps should be selected unless specially contraindicated, because the operation will be easier and at the same time safer for mother and child.

Since septicæmia is the chief cause of maternal danger after version, the more thoroughly we adopt antiseptic measures the more favorable

¹ Exceptionally, the high operation with axis-traction forceps will succeed in the most unpromising cases. Some time ago I succeeded in delivering with forceps a living full-term child through a conjugate of 7.5 cm. when version was impossible.

will be our results. There really seems to be no good reason now why the risk of maternal injury from septic absorption should not be reduced to a minimum.

As version is an operation which the general practitioner seldom needs to perform, he is very apt to forget its technique. It would be impossible here to describe all the different manœuvres which sometimes prove useful in complicated cases, and it would be equally impossible for the practitioner to remember them. He should never forget, however, that an exact diagnosis is far more important than a theoretical knowledge of operative methods if he would perform version skilfully. When a practitioner is able to map out correctly the position of the fœtus and its relations to the maternal parts, and form a clear mental picture of the same, he will not need to burden his memory with details, but will realize that in every case he has to deal with a mechanical problem whose solution depends upon his knowledge of general principles and the exercise of his own ingenuity and dexterity. The habitual practice of abdominal palpation in his daily work will soon enable him to obtain the diagnostic skill essential to success.

THE CÆSAREAN OPERATION, SYMPHYSIOTOMY, LAPARO-ELYTROTOMY, AND LAPARO-CYSTECTOMY.

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THE CÆSAREAN OPERATION, GASTRO-HYSTEROTOMY, OR LAPARO-HYSTEROTOMY.

IN all of the chief languages of Europe, from the *Kaiserschnitt* of Germany to the *taglio Cesareo* of Italy, the commonly accepted title of this operation may be translated the *Cæsar cut*. Possibly the name may have originated in the fabulous story told of the birth of Julius Cæsar, which appears to have had no more foundation than the similar one fabricated in regard to that of Edward VI. of England. How the title became so universal must always remain a mystery; it certainly has no classic origin or history.

The age of the operation is entirely conjectural. As a surgical measure it was first performed upon the dead to save a living child, but at what period is also unknown. Guido di Cauliaco was the first to write about it, and he recommended its performance in the event of a woman dying in advanced pregnancy: he published a surgical work more than five hundred years ago in which he particularly directed that the abdomen should be opened on the left side, "to avoid the liver." The work was long a standard authority.

The earliest operation upon a living woman which we have good reason to credit occurred "about the year 1500" (probably in 1498), and was performed by Jakob Nufer of Siegershausen, canton of Thurgau, in the extreme north of Switzerland (not in Germany, as usually reported), upon his own wife after her case had been considered hopeless by a number of attending midwives and lithotomists. Nufer was a gelder, and probably also a spayer, of cattle, and accustomed to the use of the knife: his wife appears to have been in a critical condition, due probably to the want of skill in her attendants, as the fact that she gave birth naturally to several other children at later periods shows that her pelvis was not deformed. Many authors have doubted the

truth of this delivery, for the reason that it was not reported until after a lapse of eighty-two or more years. Now, what are the facts? Dr. Gaspar Bauhin of Basle published the case in 1582 in an appendix to a Latin translation which he made of François Rousset's little work on *Hysterotomotokie*. Gaspar was the son of Dr. Jean Bauhin, formerly of Amiens, France, and was born in Basle on January 17, 1550, his father then being thirty-eight years old. The child delivered from Frau Nufer was a boy and lived to the age of seventy-seven. She bore twins at her next labor in the following year, one of whom, Johann, became a prefect and was living at the age of eighty-three, when Prof. Bauhin reported his mother's case. As there were four other children born later, there was no difficulty in obtaining an account of so remarkable an operation belonging to his own country, which does not appear at all incredible now, when we consider the fact that three midwives have done the same thing—viz. one in Charlemont, Ireland, in 1738,¹ woman saved, child dead; one in Louisiana in 1838,² woman and child saved; and one in France in 1881,³ woman nearly moribund, lost in three days, and child saved. Several operations have been claimed for the fifteenth century—one in 1424—but the records are not considered reliable. Germany's first case was in 1610.

Reasoning analogically from what has occurred in the last two hundred and fifty years, I am inclined to believe that the Cæsarean operation has in all probability a greater age than was even claimed for it by Pliny, or more recently by Jewish writers, whose statements have been discredited by their own medical authorities. If six women⁴ have in the last one hundred and nineteen years performed the Cæsarean operation upon themselves, some of whom had never heard of it, is it at all unlikely—or, rather, is it not highly probable—that women in remote ages have sought relief from the pangs of prolonged labor in the same way? If an ignorant Jamaica slave did this with entire success in 1769, is it not probable that history was only repeating itself in her case? Knives, razors, excitable and impatient temperaments and reckless disregard of consequences are as old as the Pyramids of Egypt. What, then, was to prevent the ancients from doing what the moderns have done with such marked success, saving five women out of a record of six cases?

Again, we have another evidence of the probable antiquity of abdominal delivery in the fact that since 1646 there have been no less than eleven women, far advanced in pregnancy, who have been made the

¹ Radford on "The Cæsarean Operation," p. 196, from *Edinburgh Essays*, vol. v. p. 439.

² *New Orleans Med. and Surg. Journal*, vol. xi. p. 13.

³ *Annales d'Hygiène publiques*, t. ix. 3 S., 1883, p. 103.

⁴ *Am. Journ. Med. Sciences*, Feb., 1888, p. 150.

subjects of gastro-hysterotomic rips by the horns of the bison, India buffalo, bull, cow, and ox, and that no fewer than eight women and five children escaped death.¹ Horned cattle were so much inclined to do injury by goring in the days of Moses, that he was obliged to enact laws with severe penalties attached, to meet their cases, and a special enactment was made for punishing an ox for goring a woman. No doubt in the early nomadic period just such accidents must have occurred as we find recorded, especially in India, at the present day, where abdominal lacerations by the buffalo are of very common occurrence.

If Macduff was, as he claimed, "ripped out" of his mother's womb, then the instrument of his delivery is much more likely to have been a cowhorn than a knife in the hand of a surgeon; which latter cannot be said to rip out in making the incision. Some early American ovariologists were derisively called "belly-rippers," but the term "rip" was not intended to be technically correct. One writer in this country states, as if the fact was to be held established, that Macduff had been torn out by the tusk of a wild boar, for which claim there is no historical evidence.

Prof. William S. Playfair in his obstetrical treatise appears to think that Shakespeare's "untimely rip" was indicative of a great age for the Cæsarean operation in the British Isles. After consulting the historic source from which Shakespeare drew his information—viz. *The Chronicles of Englande, Scotlande, and Irelande*, by Raphael Holinshed, London, 1577, in which we find the following: "I am he that the wizzards have told thee of, who was never born of my mother, but was *ripped out*"—I am inclined to interpret the dramatist differently, as already explained. Many a Cæsarean-delivered boy has been named Cæsar or Macduff without due investigation into the claims of either to have been similarly liberated from the uterine cavity. Of the eleven cattle-horn cases, three belong to the credit of the United States, and one each to Mexico, Scotland, India, Holland, Germany, Spain, France, and Italy.

Among uncivilized nations the inhabitants of Uganda in Central Africa appear to be the only people who have been in the habit of performing the Cæsarean operation. This fact was brought to light by Robert W. Felkin, F. R. S. E., of Scotland, who was witness to the performance of a gastro-hysterotomy in 1879 by a native operator upon a young woman, which resulted favorably to her and her child.² How old this operation is in Africa it is impossible to determine. It is performed with a considerable degree of skill, and certain steps in it appear to indicate that it is of ancient origin. Thus, before the operator takes

¹ *Am. Journ. Obstetrics*, July, 1887, vol. xx. p. 673; vol. xx. pp. 1033-1036.

² *Edinburgh Med. Journ.*, April, 1884, pp. 922-930.

up the knife he washes the abdomen and his hands in palm wine, a fluid used extensively in the washing processes of the Egyptian embalmers. Then, again, the abdominal wound is closed by long pins and the figure-of-8 suture, as in operations for hare-lip five hundred years ago. How the *fibula* was used for abdominal wounds in the time of Celsus¹ we are not informed, but it was evidently some kind of pin, to be employed when the tied suture failed to bring the edges of the wound in close apposition. It is remarkable that the African barbarian should be so far in advance of the Chinese and Japanese in operative obstetrics.

INDICATIONS FOR THE OPERATION.—These may be divided into *imperative* and *relative*. There are conditions, either the result of pelvic deformity, pelvic exostosis, or obstruction by tumors, which render delivery *per vias naturales* absolutely impossible. There are others in which foetal destruction may accomplish delivery, but at a risk greater than under the Cæsarean operation as it is now performed in Germany. And there are others, again, in which it becomes important to decide between craniotomy and the Cæsarean section, weighing a prospective risk, which may be less under the former, against a somewhat greater danger with a saved foetus under the latter. If a deformed pelvis is only a little too much contracted to admit of the passage of a living foetus at maturity either under nature's efforts or by the use of the forceps, craniotomy may be performed with very little danger to the woman; and in the view of a large proportion of obstetricians this is the proper management for a first labor. In case of a second impregnation the rule is to bring on labor prematurely, and thus save the life of the foetus. But what is to be done in the number of cases, especially among the poor, where they chiefly exist, in which the accoucheur is not consulted until the foetus is near its full maturity, and in which craniotomy has been already once or several times performed? And suppose, in addition to this, the parents are anxious to have a living child, and the woman, after being informed as to the true risk of the Cæsarean operation, is still willing to run it, is it proper to perform the new laparo-hysterotomy in deference to her wishes and the opinion, which is widely growing, as to the propriety of considering in such cases the rights and interests of the foetus? With regard to the religious aspect in which such a case may be regarded by a portion of the community, we have nothing to do as scientific obstetricians; but the belief of the mother may be a strong incentive toward submitting to the operation when thought desirable by the accoucheur. Different opinions prevail in different countries as to the extent of pelvic deformity or obstruction which should be encountered before an accoucheur may be considered justified in performing laparo-hysterotomy in place of cephal-

¹ Book v.

otripsy and evisceration. In Great Britain, where the mortality has been about 80 per cent. under the abdominal operation, the opposition to its performance, except in very extreme cases, has given the craniotomic alternate in women having a true conjugate of $2\frac{1}{2}$ inches and less a much higher rate of mortality than the improved Cæsarean operation has shown in Germany, where the loss has been 12 in 80. This fact should certainly cause British obstetricians to reconsider an opposition which by reason of a lessening mortality under the knife is becoming more and more groundless from year to year. It may be that there is some danger of the operation becoming too popular in countries where rickets and malacosteon are prevalent, and where the baptismal belief of the people is opposed to craniotomy; but such an alternative must in time be made to defer to the judgment of wise and careful men.

The most prevalent cause of dystocia which leads to the performance of the Cæsarean section is rachitic deformity of the pelvis, and next to it (in Europe) the pelvic collapse resulting from malacosteon. Other causes are the dwarfed or infantile pelvis; the kyphotic pelvis; the oblique pelvis of Nægele; the double ankylosed one of Robert; the exalgic pelvis; obstructions by exostoses; uterine or pelvic fibroids; cancer of the cervix or vagina; occlusions resulting from inflammation and loss of tissue; and impactions of the fœtus in a transverse position; under which last form of dystocia 12 women have been operated upon in the United States with 8 recoveries. The measure of pelvic deformity requiring the operation is differently stated by obstetrical writers according to the ruling of their respective countries, and is placed at the lowest point in Great Britain, where the life of the fœtus is generally considered of little value if that of the mother is in danger. In our own country a much lower rate of death after elective and early operations has made operators less timid; and particularly is this the case now, after the lessened American mortality of the past two years, which promises to become much less still, in the future, particularly in hospital practice under which, up to December 1, 1886, all the operations, 9 in number, proved fatal. But since that date 7 women and 10 children have been saved out of 11 hospital cases, one of the 3 fatal ones being in the last stage of cancer.

RISK IN OPERATING.—This has been very materially diminished, both in Europe and America, in the last six years. In considering the amount of danger we must first estimate what legitimately belongs to the operation; and, second, that which is added to it by delay and futile attempts at delivery. The health of the patient prior to the commencement of labor has often much to do in determining a fatal result, as she may be the subject of some acute or incurable malady. If an operation is elective, the woman in good condition and of temperate

habits, the past record of the United States shows that the mortality has been only about 25 per cent. against a death-rate of about 75 per cent. under similar conditions in Great Britain. This reversal of figures shows that the relative advantages of the English and American women are greatly in favor of the latter. The American patient is, on the average, better clothed and fed, more comfortably housed, and much less addicted to beer- or gin-drinking, than the English woman, and has only been 21 times operated on in hospital out of 175 cases. The English subject is, as a rule, much poorer and has far less stamina than the American woman; hence the fact that so small a proportion of the English recover after abdominal delivery.

Patients in country and village practice in France, Belgium, and Germany, and particularly where the same operator has had a series of cases, have in the past made a larger proportion of recoveries than in the larger towns and cities: this was also true of our own country until quite recently. Prior to a few years past the chief operators of Europe were Dr. Ludwig Winckel of Gummersbach, near Cologne, who operated by *true* Cæsarean section 13 times, saving 5 women and 10 children: Dr. J. P. Hoebeke of Sotteghem, East Flanders, who had 9 operations, saving 5 women and 9 children, one woman bearing twins; Dr. Dècouene of Courtrai, Belgium, who operated 6 times, saving 5 women and 4 children; and Profs. Stolz and Kilian of Bonn, who each operated 7 times and saved 4 women. Several operators have exceeded the number of cases in the hands of these men, in Naples, Milan, and Cologne, but the mortality was proportionately much greater. The general mortality in the United States has been 62 per cent., and in England about 80 per cent. We have surpassed England also in the number of cases operated upon, the American record counting 175 operations with 65 women saved, and the British 152 operations with 30 women saved: the full record of Great Britain has not been taken, as a diligent search for unpublished cases has not been made, as has been done in the United States. The work of the last two years in the respective countries shows a great proportionate increase in the number of operations in the United States over preceding years, and as compared with Great Britain, and a very encouraging diminution in the death-rate, due almost entirely to the introduction of aseptic management in the cases and the new method of closing the uterine wound.

CAUSES OF FATAL RESULTS.—Delay in operating, especially in this country, has had a great deal to do with the high rate of mortality in the past. Delay alone, as under a midwife who has simply waited for nature to accomplish the delivery and has not interfered, is not so potent a factor of evil as where the time has been largely consumed by futile attempts to deliver, under which the foetus has perhaps died. There is a very decided connection between the fate of the child and

mother, as will be seen by an examination of our Cæsarean record. More children than women are saved, it is true, but in a series of operations where scarcely a child has been found dead on delivery, it will be noticed that a large proportion of women have recovered, and *vice versa*. The continuance of severe and oft-repeated labor-pains where there is no advance in the foetus has a very depressing effect upon the woman, both as to her mind and strength, and a uterus kept long in action not only fails to contract well upon being emptied, but its tissues are injured by the muscular action and resistance, and do not heal readily after the incision is closed either by contraction of muscles or by sutures inserted. The exhaustion produced by labor favors the production of uterine hemorrhage from inertia, the consequent formation of a cardiac embolus, and death by collapse. As rachitic women are generally dwarfed and their physical strength is below the average, death from shock and exhaustion very frequently follows an operation executed after delay; and a labor of only a few hours in a dwarf may produce great prostration and result in death. A rachitic dwarf will bear an early operation and recover, but rarely does this when exhausted by too long waiting. Under the new method, which has been so successful in Germany and Austria, promptness has been an important factor in securing success. Death by hemorrhage directly has rarely resulted after the Cæsarean section, but death from heart-bleed is no doubt more frequent than has been recorded. Peritonitis is a common cause of death. When the uterine wound is well closed by deep and superficial multiple suturing, so that blood and lochia cannot enter the abdominal cavity, the risk of this form of inflammation is greatly reduced. Septicæmia and septic peritonitis are much to be dreaded, but are more rarely fatal than before the new improvements were introduced. When the foetus is dead and putrid there is a greater than usual risk of blood-poisoning from the absorption of septic matter, and such cases are safer after the removal of the uterus and its contents by the plan of Porro and Müller, the organ being turned out of the abdomen before evacuation. Some very remarkable escapes from death by septicæmia due to the removal of the atonic uterus and its putrid contents have been recorded in Europe.

MODES OF OPERATING.—Our attention must be confined to the plans under which the abdominal incision has by common consent been made in the linea alba. Few operations as grave in character have ever been performed successfully with as little assistance as some that occurred in the early days of this country. Before the use of anæsthetics and antiseptics the section was once made in Ohio under the light of a tallow candle and with the aid of two women, and the patient recovered:¹ she was a large woman and had never suffered with a bone disease. As

¹ *Western Journ. of Med. and Phys. Sciences*, 1830, vol. iii. p. 485.

delay is much more dangerous in country cases than it is to operate without antiseptic precautions and securing a full corps of assistants, the operator will be much more likely to succeed if he does not waste time in sending for distant aid. If he is confident that the operation is demanded, he can at once proceed with the aid of one physician and a few women. By the use of hot spring-water for cleansing and the aid of a woman to thread his needles he may make even an excellent substitute for the most improved technique of asepsis and the multiple uterine suturing. In cities, and especially in hospitals, success is rarely attained so readily. As the subjects and their hygienic surroundings are usually very inferior as compared to the women of the farm and village under their advantages of a free circulation of pure air, they (that is, of the city) must have every possible benefit that asepsis and a carefully-tested technique can give them; and here the city woman has the advantage that all needed aid and appliances are near at hand. The most important directions to be given both for country and city operations are—1. Let there be no unwise delay in operating or injudicious attempts to deliver *per vias naturales*. 2. Observe as great care as possible in making the person of the patient and the instruments to be used absolutely clean. 3. See that the abdominal cavity is thoroughly cleansed of blood and amniotic fluid after the uterus has been emptied, and again after it has been sutured. 4. Close the uterine incision so as to prevent the possibility of fluid escaping into the peritoneal cavity and setting up septic peritonitis; to do which effectually many deep and superficial uninterrupted stitches (ten or more of each) should be inserted, and the edges of the peritoneal coat of the uterus welted inward into the incision.

Modern Antiseptic Operation.—The patient is to have her bowels and bladder well emptied; she is to be warmly dressed, and after being etherized in bed is to be removed to the operating-table, the temperature of the room being at 75° or 80° Fahr. The room may be prepared previously by spraying with dilute carbolic acid, if thought desirable, but the use of spray during the operation has been very generally abandoned, as in ovariectomy, because of its poisonous effects on operator and patient. After placing the woman as for ovariectomy, her abdomen is to be washed with warm water and soap, then with ether, and finally with a 5 per cent. solution of carbolic acid or 1 : 1000 corrosive-sublimate water. The vagina is to be washed out with a 2 per cent. solution of the former or 1 : 2000 of the latter. The operator stands to the right of the woman, and his chief assistant opposite to him. Four assistants constitute a full corps when they are available—one to give ether; one to attend to the sponges and thread needles (this may be a nurse); a third to hand instruments; and a fourth to manage the abdominal parietes, keep back the intestines, compress the abdomen against the uterus, use manual compression if

required, apply compressing forceps, etc. The resuscitation of the fœtus, if requisite, is generally committed to some visiting physician present. The incision is to be made in the linea alba from the umbilicus to one and a half inches from the symphysis pubis, and may be carried through and beyond the navel in cases of dwarfs. Spring forceps are to be used to compress any bleeding vessels in the abdominal wall, and the uterus is then to be incised longitudinally with a scalpel to the extent of about five or five and a half inches, care being taken to avoid the fundus and cervix because of their greater vascularity; or the wound may be made partially and extended by a probe-pointed bistoury. The first assistant may now hook up the uterus by inserting an index finger at each end of the incision, as recommended by Dr. Ludwig Winekel, or he may use manual compression of the cervix to check hemorrhage. If the waters have not been evacuated, the membranes are to be torn and the patient turned upon her side, or the waters can be evacuated *per vaginam*. In hospital service the use of the caoutchouc dam and apron placed under the patient will be of great value in conducting all fluids lost or used in washing into a waste-bucket, as employed by Dr. H. A. Kelly of Philadelphia. If the fœtal head presents at the wound, the operator should deliver it first; but if not, he should seize the feet, turn, and deliver. By many, the operation under long abdominal incision is preferred, in which case the uterus is turned out entire, the cervix is constricted by the elastic tube of Esmarch, and the organ is then incised and evacuated, the abdomen having been previously protected by cloths or a caoutchouc diaphragm to prevent the fluid contents from entering the abdomen. If asphyxiated—which is generally the case where the Esmarch constriction is used—the fœtus should be carefully attended to until it breathes satisfactorily. The woman should receive a hypodermic injection of ergotine, and when the placenta separates the operator should remove it, cleanse out the clots, and mop out the uterine cavity with carbolized sponges. If there is hemorrhage, he should swab the uterus with vinegar, tincture of iodine, or alcohol, and in very extreme cases with a solution of persulphate or perchloride of iron. In a case under Dr. Fasola of Florence, Italy, the bleeding was so uncontrollable that he was forced to complete the operation after the method of Porro, in order to save the woman from death by hemorrhage: the patient recovered. This must have been a very exceptional case, as I know of no other like it. If the placenta is under the line of incision, it should be separated on one side, or it may be necessary to tear through it to effect a hurried delivery. Compressing forceps may be required temporarily to check the bleeding from the edges of the uterine wound, and ligatures have in some instances been used. This tendency to hemorrhage is very variable. I have seen a placenta under the line of incision separated entire before delivery with very

little bleeding, and I have seen a very active hemorrhage from a vein in the edge of the uterine incision where the placenta was attached posteriorly. If the cervix uteri has not been dilated before the operation, a utero-vaginal drainage-tube should be inserted. The uterine wound is next to be closed with deep-seated and superficial sutures of carbolized silk. The deep sutures should pass down nearly to the uterine lining, and the superficial ones should be inserted between them, so as to turn in the peritoneum and bring its serous surfaces in apposition, as this plan secures the most rapid union. Many stitches are much better than a few, because the individual tension is correspondingly less and the wound is much more tightly secured against leakage. The interrupted suture, making a directly opposite antagonism instead of an oblique one, is better adapted to closing a shortening wound than an uninterrupted one, which by this change of length has a tendency to slacken. The next step is to cleanse the abdominal cavity by pouring in warm distilled water, which when removed by stem-sponges may be succeeded by still further mopping out with carbolized sponges. The abdomen, after being closed by silver-wire or silk sutures, is to be carefully washed and dried, and then dressed antiseptically, as after an ovariectomy.

Prior to operating, the instruments, sponges, and cloths to be used are to be placed in a 2 per cent. carbolic-acid solution; the hands of the operator and his assistants are to be scrubbed with a nail-brush and with warm water and soap, after which they are also to be treated with the carbolic solution; and the hands soiled in the operation are from time to time to be re-washed.

Uterine Sutures.—The greatest improvement ever made in laparohysterotomy was the introduction of the uterine suture; and it is a marvel to us now that the world of surgery was so long in discovering its value. Timidly initiated one hundred and nineteen years ago, it was nearly a hundred years before it came to be regarded as of any special use in saving life, and even then there were few to advocate it, and they were chiefly in our own country. Why an internal wound which was liable to relax, elongate, and gape open was allowed for more than two hundred and fifty years to depend for its closure upon the contraction of the uterus and its continuance is a complete mystery. Hypotheses as to the dangerous consequences of uterine suturing no doubt ruled it out of the field of experiment, and the opposition excited by its first trial was potent enough to keep it out of Europe during an interval of sixty-seven years more. The first operation upon record in which uterine sutures were used was performed by M. Le Bas, a surgeon of Moullicron, France, on August 27, 1769, the case being one of impaction with an arm protruding, the fœtus dead, and the woman three days in labor.¹

¹ *Journ. de Med., Chirurg., Pharmacie, etc.*, tome xxxiv. p. 177. 1770.

As the report was made in a letter by Dr. Gallot, we are simply informed that the uterine wound was closed by "two or three points of suture" and the abdomen by four. This was M. Le Bas' second operation, and both ended successfully. A very extensive search for cases has failed to find a second between 1769 and 1828, when a Fairfax county charlatan of Virginia, who had quite a reputation as a bold surgical operator, repeated the experiment upon a mulatto multipara of twenty-five in a case of obstruction of fifteen months' standing due to occlusion of the cervix and a calcareous incrustation over the internal os uteri. Two or three sutures of silk were used in the uterine wound, and the case progressed favorably until the middle of the second week, when, by partaking largely of animal food and cider, she brought on an attack of peritonitis that proved fatal in forty-eight hours.¹ The third operator was Dr. Wiefel of Hüllesenbush, whose case was reported without the year in February, 1838, and must have been operated upon on August 22, 1837, or earlier: he used only one suture; the patient recovered.² The fourth operation was that of Godefroy de Mayenne, who operated on Madame Patrice of Oiseau, near Mayenne, on March 27, 1840. This woman was rachitic, 4 feet 3 inches high, a primipara of forty-two, and with a conjugate of 2 inches. Three sutures of waxed silk were used to close the uterine wound, and the woman and child were saved.³ The second case in the United States was that of Dr. Gamaliel W. Holmes of Early county, Georgia, in 1851; sutures of silk, woman lost.⁴ The third was that of Dr. Frank E. Polin of Springfield, Kentucky, who operated upon Mrs. Mary Brown on November 25, 1852, the cause of dystocia being a hydrocephalic and strongly ossified head. The original statement was that silver wire was used to close the uterine wound, but more recently his brother has claimed that he employed catgut. I am inclined to credit the first, which was said in 1880 to have been taken from his own notes.⁵ Mrs. Brown bore two children at later periods, and was living thirty years after the operation. In 1867 there were two more cases in the United States—one under Dr. T. Beers Townsend of New Haven on November 15th, and the other under Drs. D'Aquin and Brickell of New Orleans on December 21st. The first subject was black, sixteen, conjugate one and a half inches, in labor sixty-two hours and a half; three uterine sutures of fine hemp were used; woman recovered. The second subject was a French creole, twenty-three, with occlusion of vagina and os uteri; in labor ten days. Uterus flaccid after delivery; wound closed with six silver-wire sutures. Woman alive and well in November, 1877; was not again pregnant: no inconvenience experienced from presence of wires. The system of

¹ *Amer. Journ. Med. Sciences*, O. S., vol. xviii. p. 257, 1836.

² *Casper's Wochenschrift*, S. 123, 1838.

⁴ Private record.

³ *Gaz. méd. de Paris*, No. 28, 1840.

⁵ *Medical Herald*, vol. ii. p. 352.

uterine suturing has been very gradually introduced into the United States, until now scarcely a case is reported in which it has not been used. When we read of the success that attended the early cases we are astonished that the plan of suturing was not long ago adopted. Prof. Brickell of New Orleans advocated the introduction of uterine suturing in his lectures as early as 1856, and eleven years later tested it with satisfaction in the case already mentioned.

The closing of wounds of the abdomen by deep-seated and superficial sutures was taught eighteen hundred years ago, in the time of Celsus, but the application of this method to the wound of the uterus was not made until quite recently. I have failed to find any case in which more than one line of sutures is reported to have been taken before September 18, 1874, when Dr. R. O. Ingraham of Montezuma, Macon county, Georgia, is said to have inserted three deep sutures, three half-deep, and four in the peritoneum, of carbolized silk. The woman recovered, and was living several years later, but her case was not reported until after a lapse of eleven years, when the improved operation of Germany had been performed twenty-three times, and not until after he operated a second time, in the same way, but with a fatal result, in 1882.¹

Multiple suturing in two rows was first tested in May, 1882, at the suggestion of Dr. Säger of Leipzig, by Dr. Leopold of Dresden, the number used being twenty. Prior to this time but few sutures, all deep-seated, except perhaps in one instance, were inserted, varying in number from one to ten.

NEW METHODS OF PERFORMING LAPARO-HYSTEROTOMY.—Germany has in the past ten years furnished the Cohnstein, Frank, Kehrer, and Säger processes, only one of which has well stood the test of experience—*i. e.* the last. The first three may be found fully explained in the *International Encyclopædia of Surgery*, vol. vi. pp. 655-658.

The Säger Process, also known as the New or Improved Cæsarean Operation.—To Dr. Max Säger of Leipzig are due three important changes in the manner of closing the uterine wound—*viz.*: 1. The use of a largely increased number of interrupted sutures. 2. The arrangement of the sutures into two rows, deep-seated and superficial. 3. The application of the sero-serous intestinal suture of Lembert to the uterine wound, so as to welt in the peritoneum and secure an early union by maintaining the serous surfaces in contact. In his original scheme it was proposed to resect a portion of the muscular edges of the uterine wound, and to dissect a narrow portion of the peritoneal coat from the muscular, so as to favor a ready turning in of the former; but after a few trials it was discovered that the peritoneum could be made to slide over the muscular coat without dissecting up the former or resecting

¹ *Atlanta Med. and Surg. Journ.*, vol. xxvi. p. 469, 1885-86.

the latter, except in a few cases where tissue-changes prevent the sliding process from being carried out; and this requirement of the original scheme was abandoned. The principle upon which the resection and "undermining" were founded remains in full force, as these were simply means for the accomplishing of an end which can be attained without them. To say that these were the main changes introduced by Dr. Sänger, and that their abandonment left him without any title to credit, is an error, for the three points of improvement remain intact. In August, 1880, Dr. Sänger performed his first Cæsarean operation, closing accurately the uterine wound with the peritoneum edge to edge, and the woman recovered. This was not what has since been called by his name, as not one of the three features mentioned were then tested. This case, however, led him to investigate the historical features of the Cæsarean operation, and to prepare a monograph of two hundred pages in which he presented for consideration and trial the improvements already named. The paper was completed in December, 1881, and appeared early in 1882.

The plan of operation is as follows: The abdomen is washed and the vagina disinfected as directed for the "modern antiseptic operation," after which the incision is made to correspond with the plan to be carried out. If it is proposed to turn out the uterus before opening it, the incision is to be made of suitable length. When this is done the upper part of the wound is to be prepared by the insertion of two or more long, slack sutures, to be drawn upon after the uterus is turned out. The next step is to bring out the uterus by the fundus; then to draw the long sutures upward toward the ensiform cartilage, so as to close the wound beneath the uterus; then to protect the abdominal cavity by surrounding the cervix with a sheet of caoutchouc moistened with a 5 per cent. solution of carbolic acid; then to constrict the cervix with Esmarch's elastic tube; and, lastly, to evacuate the uterus by incising its anterior wall vertically at its middle third, so as to avoid the fundus and cervix. The fœtus will be found asphyxiated because of the temporary arrest of its blood-supply, and must be given to an assistant selected to resuscitate it. When the uterus is well contracted the tube may be removed, and any bleeding from the wound may be stopped by forceps. The wound in the uterus is now to be closed by a number of deep-seated sutures made to pass through the peritoneal and muscular coats, but to avoid the mucous coat. These may be made of virgin-silver wire or carbolized silk; catgut is very unreliable, as it either stretches or the knots become niftied. After these are tied and the peritoneum is turned in by sliding and the use of the handle of a scalpel, this coat may be still more drawn upon by alternate superficial sutures of carbolized silk introduced after the manner of Lembert, which when tightened will fix the serous surfaces in contact and secure

an early union. Before any of the uterine sutures are tied the uterine cavity is to be washed out with an antiseptic fluid, and if the cervix has not been well dilated, drainage should be secured by the insertion of a utero-vaginal tube: abdominal drainage is not required, as there is no leakage where the closure is properly made. The number of sutures employed in different operations has varied from twenty to thirty-five.

Where the operation by short abdominal incision is preferred, the cervix may be constricted by manual compression to avoid hemorrhage until the uterus has contracted, when the organ may be washed out, then sutured, and the abdominal cavity cleaned by irrigation with warm distilled water. Sir Spencer Wells has taught that long abdominal incisions in ovariectomy added to the risk of the operation. This is plausible but fallacious, and is not borne out by the experience in Porro operations after the Müller plan. In ovariectomies the simple cases require but a small incision, and where a long one is made it is because it is rendered necessary by reason of adhesions to be overcome or of complications adding to the risks of the case; hence the real danger under a long incision does not lie in the incision itself. This is also shown to be true by the results of the Säger Cæsarean cases.

In exceptional cases the peritoneal coat has been found so tightly adherent to the muscular that resection and separation of the muscularis and peritoneum have been found requisite; and in one American case because of the existence of a mural fibroid three-quarters of an inch of the muscularis was excised, with the recovery of the patient. Small mural fibroids when cut through and closed up in the wound have suppurated and caused death by septic poisoning. In one fatal case three such tumors had been cut through.

The improved Cæsarean method of Säger has worked a revolution in opinion as to the dangers of laparo-hysterotomy delivery, and craniotomy is being placed more and more upon the defensive. By prompt action, the use of antiseptics, and delivery by the improved abdominal method, Germany has largely reduced the mortality of the Cæsarean cases in her maternities; and other countries have profited more or less according to the closeness of their imitation and faithfulness in carrying out the instructions she has given.

Results Attained by the Improved Cæsarean Operation.—The operation, as far as reported, has been performed 149 times by 82 men in Germany, America, Austria, Italy, Russia, Switzerland, Holland, France, Belgium, India, and Denmark, saving 108 women and 136 children (the fate of 3 children not having been given). Germany, having exercised the greatest degree of care and having adhered the most rigidly to the technique, has saved the highest percentage of cases: 80 operations have been performed in 18 cities and towns by 38 operators, with

only 12 deaths. Prof. Leopold of Dresden has operated 17 times with 3 deaths—a success which is a fraction below the general result under the whole of the German operators. The Austrians have had 17 operations and saved 12 women and 15 children. In our own country there have been 22, but with a loss of 13 women and only 3 children. In the past two years there has been a remarkable change for the better in the United States, and now cases in hospital are much more rarely fatal than in former years, and even less dangerous to operate upon than in private houses.

The improved Cæsarean operation cannot be made to work miracles, and it should be understood that it largely depends for success upon the prior condition of the woman. Cases do recover under adverse circumstances that would be fatal under the old method, where antiseptics and uterine closure were not used; but a very early operation on a healthy woman, especially in America, performed according to the old method, gave a greater average promise of success than the new one now offers in women exhausted by long labor where futile attempts have been made to deliver *per vias naturales*. Although a patient may recover after a long labor where the improved operation has been used, she is not likely to make a rapid convalescence. Exhaustion of system favors attacks of peritonitis and crural phlebitis. Sepsis has much to do with these sequelæ, but there are cases of which sepsis is innocent as a factor. Long-continued action of the uterine muscles produces a condition which, like a contusion of parts, is antagonistic to union by the first intention: the peritoneum will heal under multiple suturing and prevent leakage, but the musenlaris will gape; and if it does not favor septic absorption in a given case, the union may be slow and tedious: both the uterine and abdominal wounds may reopen, and unite secondarily by granulation, as sometimes happens. To secure a satisfactory result, not only as to the life of a patient, but as to rapidity of recovery without drawbacks, the new operation requires to be done early, and that the subject should not be anæmic, coxalgic, plithisical, intemperate, or otherwise unhealthy. As Cæsarean subjects are generally of the poorer class, they can be better cared for in hospital than at home, and should be seen, if possible, by the operator prior to the commencement of labor. The possibility of delivering a living fœtus in a case of pelvic obstruction ought to be determined by the touch and pelvimeter, and never by experimental trials of the forceps and by attempts at version, because success in the Cæsarean operation depends very much upon the physical strength of the patient at the time it is commenced. If one hundred rachitic women in the last days of gestation should enter a hospital for delivery, and should be operated upon by the method of Sänger early in labor, I should expect to find that 80 per cent. of the women had recovered, or perhaps as high as 90 per

cent. A promising case is often rendered unfavorable, if not actually hopeless, by attempts to prevent a resort to the Cæsarean operation, the fear of which has often led to its being made a final and fatal mode of delivery when it should have been the contrary.

An examination into the causes of death after the improved Cæsarean operation will develop the fact that few cases die as a direct result of the surgical delivery. A few are hopeless from pre-existing disease, or may be actually moribund, as from cancer, cardiac lesions, or granular degeneration of the kidneys. Some die of shock and exhaustion as a natural sequence of a long labor in which futile attempts to deliver were made by the forceps, version, or craniotomy, singly or all three. Some have died of post-partum conditions, entirely independent of the effect of the knife, as from diphtheritic endometritis or other disease endemic in hospital. Even peritonitis has been found on autopsy to be entirely independent of the operation or the parturient state; as, for example, where it was produced by a perforating ulcer of the intestines, cicatrices of pre-existing ulcers being found, as in the third case of Prof. Chiara of Florence, Italy, operated upon on January 5, 1888. Death from septicæmia or septic peritonitis may occur in a promising case, but such deaths are rare under the aseptic treatment. Saline purgation and abdominal irrigation have saved cases of peritonitis where the symptoms were of a very grave character. Death by secondary hemorrhage, so common at one period, is now of exceedingly rare occurrence: it was never a common result of the operation in America.

THE PORRO-CÆSAREAN SECTION, LAPARO-HYSTERO-OÖPHORECTOMY.

It is an absolute essential of the Porro supravaginal amputation of the uterus that laparo-hysterotomy with delivery of a fœtus shall have preceded it; hence the impropriety of giving the name of the Pavian professor to a supravaginal amputation following a rupture of the organ, as he styles his modification a "utero-ovarian amputation as completive of the Cæsarean operation." Now, what is a Cæsarean operation? The abdomen must be incised and a pregnant uterus must be cut open for the delivery of a fœtus, or the section is not Cæsarean. To open the abdomen and remove a fœtus from the peritoneal cavity or from an extra-uterine cyst is not a Cæsarean operation, although often erroneously called such: the fœtus must be in the uterine cavity, and the operator must remove it by abdominal and uterine incisions. This is a very old and unalterable definition of the term "Cæsar cut;" and the reason for it is based on the fact that classification and the records of mortality demand that the three forms of cases should not be statistically confounded. The Cæsarean and Porro-Cæsarean opera-

tions are intended to save two lives; laparotomy after ruptured uterus is almost universally performed after the foetus is dead, and laparo-cystectomy in extra-uterine pregnancy has until quite recently had a very high mortality for both child and mother.

HISTORY.—The idea of removing the uterus after performing the Cæsarean operation seems to have successively entered the minds of quite a number of obstetricians and vivisectors during a period of more than a hundred years. Prompted by a desire of the celebrated Antonio Coechi, Dr. Giuseppe Cavallini, surgeon-in-chief of the Santa Maria Nuova Hospital of Florence, was led to try a series of experiments upon dogs and sheep to determine the danger of extirpating the uterus, with a view of trying it as a means of curing cancer of that organ. Dr. Cavallini extended the experiments in the direction of obstetrics, and successfully exsected the womb of a bitch that contained nine pups; after which he wrote: "I do not doubt that the uterus is not at all necessary to life; but whether it may be plucked out with impunity from the human body we cannot be certain without a further series of experiments of this kind, *which perhaps a more fortunate generation may obtain.*" Dr. Cavallini published an account of his experiments in a monograph in 1768 entitled *Tentamina medico-chirurgica de felici in quibusdam animantibus uteri extractione*. The idea of Cavallini contemplated a complete removal of the uterus, and not an amputation at its neck. It is a singular coincidence that a Mrs. Cavallini should have been the first subject of uterine removal under the Cæsarean scheme of Prof. Porro one hundred and eight years later.

The next to consider the same subject was Dr. G. P. Michaelis of Marburg, who wrote in 1809: "It is indeed a question whether the Cæsarean section would not be less dangerous if with it were combined the extirpation of the uterus." Here, again, we have the idea of complete hysterectomy.

Dr. James Blundell of London, whose obstetrical observations and opinions placed him far in advance of his time, and make his writings of much value even now, was led by a series of experiments to express the same opinion, which was thought to be very wild and visionary by his colleagues. After saving three rabbits out of four under hysterectomy, he wrote in 1828 as follows: "In speculative moments I have sometimes felt inclined to persuade myself that the dangers of the Cæsarean operation might be considerably diminished by the total removal of the uterus." . . . "Perhaps the method of operating may hereafter prove an eminent and valuable improvement." Here we have, for the third time, the idea of removing the entire uterus.

Dr. Jéser in 1862 removed the gravid uteri of four bitches, and saved two of them, as reported by Dr. Fogliata.

Dr. Giacinto Fogliata of the Veterinary School of the Royal Uni-

versity of Pisa instituted a series of experiments in 1874, and saved three non-gravid bitches out of four after the removal of their uteri.

Prof. Edoardo Porro, then of Pavia and now of Milan, like Prof. T. Gaillard Thomas of laparo-elytrotomie fame, was in entire ignorance of the work of his predecessors, and instituted a set of experiments like those of Fogliata, also in 1874, by removing the gravid uteri of three rabbits, all of which recovered. He had performed a Cæsarean operation in Milan in July, 1871, upon a young rachitic primipara, who had been in labor twelve hours, but lost the patient in fifty hours from internal hemorrhage and metro-peritonitis: the child was saved. As the old Cæsarean method had been universally fatal in Pavia, and a mere fraction out of a large number of cases had escaped in Milan, Prof. Porro made his experiments in the hope of finding a less fatal scheme of delivery, and was happily successful.

He was not the first operator who performed supravaginal amputation of the uterus after a laparo-hysterotomy, but was the first to do so as the result of a predetermined plan of operating. In 1869, Prof. Horatio R. Storer of Boston (now long a resident of Newport, R. I.) performed the Cæsarean operation in a case of obstruction from a fibro-cystic tumor, and was *forced* to remove the uterus to prevent the woman from bleeding to death, as was done of necessity in 1886 in the experience of Dr. Fasola of Florence, already mentioned. Prof. Porro operated upon Mrs. Giulia Cavallini (strange coincidence in the name!) on May 21, 1876, one hundred and eight years after Dr. Giuseppe Cavallini had written in so predictive a way about the future of hysterectomy. Signora Cavallini was a rachitic primipara of twenty-five, 4 feet 10½ inches in height, and having a true conjugate of $1\frac{9}{16}$ inches. She had been in a private room of the hospital and under a tonic regimen for twenty-four days prior to the operation, which differed in one important feature from the propositions of Cavallini, Michaelis, Blundell, Jéser, and Fogliata in that amputation of the uterus at the cervix, and not the entire extirpation of the organ, was in contemplation.

Mode of Operating.—According to the directions of Prof. Porro, the first steps in his method are the same as for the modern antiseptic Cæsarean section, with the uterus *in situ*, up to the point where suturing of the uterine wound is to commence. Here the whole plan changes, and supravaginal hysterectomy, including the tubes and ovaries, begins by first turning out the organ through the abdominal wound, and then holding it vertically until the wire loop of the constrictor of Cintrat is passed around the cervix at a point opposite the internal os uteri and tightened by turning the screw; after which the cervix is to be cut through about two centimeters ($\frac{3}{4}$ inch) above the wire and the mass removed. The abdominal cavity is next to be cleansed with carbolized sponges, and a five-millimeter drainage-tube

is to be passed through the abdominal wound, the Douglas pouch, and out by the vagina. The abdomen is now to be closed with silver-wire sutures, the stump touched with perchloride of iron and fixed in the lower angle of the wound, and the parts dressed with simple applications.

The first subject of the operation recovered in forty days, and lived several years: the child was saved.

Numerous changes have been made in the operation since its initial trial, some of them being for convenience, while others have been of vital moment, and a few very fatal. Transfixing pins were adopted to prevent the stump from falling in after the constricted part should drop off—an accident that happened early in the history of the operation. Changes were made in the form of constrictor, some preferring that of Kœberlé or Maisonneuve or the ovariectomy clamp of Spencer Wells; others cut through the cervix with the *écraseur* of Chassaignac or Billroth. The drainage-tube was abandoned or used only in the abdomen. Operations were performed under spray and Listerian treatment used: they were also made bloodless in large measure by the application of Esmarch's tubing around the cervix. To avoid the placenta the uterus was incised transversely above the internal os and opened to the required size by laceration. Of all the changes, two deserve special consideration—viz. the modification introduced by Müller of Bern, Switzerland (Case 9 in chronological order), and by Veit of Bonn, Germany (Case 50).

Müller's Modification.—This was introduced by Prof. Müller at his first operation, on February 4, 1878, as an improvement upon the eight operations that preceded it, and as especially adapted to cases like his own where the fetus is dead and putrid and there is danger of septic matter escaping into the abdominal cavity upon delivering it. The subject of his operation was a malacosteon multipara of thirty-seven, who had been three days and a half in labor and had a pulse of 136. After making a long incision the uterus was drawn out and then incised, the abdomen having been previously protected against the admission of fluid and the cervix constricted. By the removal of the uterus and its septic contents the woman's pulse was reduced after the operation to 96, and by the next day to 84, while the temperature fell from 102° to 97° Fahr. This patient, however, made a narrow escape, as her pulse on the eleventh and twelfth days reached 140 and 150 respectively, and there was a gangrenous appearance about the abdominal wound. The result of the case led to the belief that the modification was of value over the original plan in some cases, and to its adoption by many as a substitute. The plan of opening the uterus outside of the abdomen was next adopted by Prof. Chiara of Milan in Case 13. Labor was induced in the case of a rachitic dwarf, 4 feet 3½ inches in height and twenty-three years old, and after it had progressed twelve hours

the section was made. The operation saved the child, but the mother was lost through septic peritonitis on the fourth day. This put an end to the plan in the Maternity of Milan, but in many other hands it was quite a successful method, and eventually became part of the Säger scheme of operating. As the constriction of the cervix produces asphyxia in the fœtus, the operation should be rapidly completed after the wire is drawn, and the child taken in hand for resuscitation. The Müller plan of operating has saved about half of the cases subjected to it. The uterus cannot always be turned out after the long incision is made, and in this event the operation must be completed with the uterus *in situ*.

Veit's Modification.—Not satisfied with certain features in the Porro and Müller methods, in each of which the cervical stump is dressed externally, and for reasons of safety contemplated in the original design of the former, Prof. Gustav Veit of Bonn, Germany, adopted the plan of treating the stump as a pedicle by ligating and dropping it into the pelvic cavity, and tried his first experiment with it on March 21, 1880, which resulted in the death of the patient from septic peritonitis in seven days. Three other operators, all within a period of five weeks and in chronological order—one of them experimenting upon two subjects—repeated the same method, with a fatal result to each woman. Six months after his first trial, and after five women in all had been lost, Prof. Veit made a second attempt, and was then successful. Cases 7, 8, 9, 10, and 11 under the same intraperitoneal method were all fatal. Case 12, under Dr. Kabierski, Jr., of Breslau, Case 13, under Dr. August Martin of Berlin, and Case 14, under Prof. Fritsch of Breslau, ended in recovery. But for the increased measure of danger the intraperitoneal method of treating the stump in supravaginal hysterectomies would be for many reasons preferable to the extraperitoneal, and on this account various methods of treating the amputated portion have been tried by different operators in the hope of diminishing the risk of hemorrhage from shrinkage and of septic poisoning from the dropped-in stump. The amputated end has been ligated with silk in several ways, and with silver wire; it has been cobbler-stitched; and the peritoneum has been sewed over the end by numerous stitches. It has also been proposed to turn the stump into the vagina to avoid the danger of its presence within the peritoneal cavity. Supravaginal amputation of the uterus is much less under control in a Cæsarean than in a non-pregnant case, for the reason that in the former the cervix is greatly larger, and shrinkage may take place in a few days from the size of the wrist to that of a finger, as shown by the record of the Prevôt case of Moscow, Russia, where the hemorrhage repeatedly recurred from the constricted stump, which was secured externally by a *serre-nœud*, and was the cause of the woman's death. The causes of death under the Veit

modification have been shown by autopsy to have been mainly septic or hemorrhagic, as might be theoretically presumed. The dragging of the cervix and vagina upon the abdominal cicatrix is at first a serious objection to the extraperitoneal operation, and this attachment is in the way of the expansion of the bladder; but in time the tension is overcome and the remnant of the stump becomes an elongated cord. The much greater safety of the original Porro plan of treating the stump should make it decidedly preferable to that of Veit.

Other Minor Changes.—We are all familiar now with the application of the method of Esmarch to the control of hemorrhage in the Cæsarean operation, and especially as employed in Germany under the improved method. As Prof. Carl C. Th. Litzmann and Prof. Esmarch both lived in Kiel ten years ago, it was very natural as well as wise in the former to make trial of the elastic tube of the latter in a Porro operation which he had occasion to perform on June 14, 1878, and, although the case terminated fatally, the result by no means invalidated the plan, for the patient had been three days in labor and was in a feverish, exhausted state; besides which the external os uteri was occluded, which afforded a lodgment for pus in the cervical canal, giving rise to septic infection, and to death on the sixth day. The compression of the cervix controlled the hemorrhage while the uterus was contracting, and thus was established the value of the apparatus in laparo-hysterotomy.

Manual compression, also now employed by some operators in preference to the Esmarch elastic tube, was introduced by Dr. Leon Oppenheimer of Wurzburg, Germany, on July 4, 1880, in a Porro operation that proved successful: he also made use of Sir T. Spencer Wells' ovariectomy clamp.

EFFECTS UPON MALACOSTEON SUBJECTS.—Although the Porro operation is much less frequently performed than it was five years ago, and has most largely fallen off in the maternities where it was once often performed, it is still of value in certain parturient conditions, such as where the uterus contains a dead and putrid foetus, or where the woman is affected by a progressive malacosteon. Several years ago I took occasion to investigate by correspondence the effects of removing the uterus, ovaries, and tubes upon the health of malacosteon subjects who had recovered from the Porro operation, and found, as I had partly anticipated, that in some instances the bone disease had been checked, and in others entirely cured, so that after having been partly bedridden they had been restored to active life, one woman taking care of the rooms in a students' lodging-house. Dr. Fehling of Stuttgart was struck with the results in three of his own recovered cases, all having been cured of the bone malady, and one who was not far advanced in the disease walking "perfectly well." From these results Dr. Fehling conceived the idea several years ago of testing the value of oöpho-

rectomy upon non-pregnant malacosteon women as a means of cure. He has, I am informed, investigated the conditions of a number of malacosteon women who have been benefited or cured by the Porro mutilation, and has begun to put into practice the plan of which he wrote to me. It is probable that the removal of the uterine appendages may cure some cases of malacosteon; but as the disease sometimes attacks in a severe form women who have never been pregnant, and even men, it is not likely that the cure can be general. Dr. Fehling found that to get the full benefit of the Porro exsection the malacosteon woman should not be permitted to nurse her child. As malacosteon proves fatal in the end, and is quite prevalent in some sections of Europe, it is important to test the effect of the only remedy that promises to cure the disease.

RESULTS OF THE PORRO-CÆSAREAN OPERATION.—There have now been more than 232 operations performed, and the method has been tested in almost all the countries in Europe, in our own country, in India, and in Australia. In a few maternities, like those of Milan and Vienna, and under a few special operators of unusual skill, as Profs. Breisky and Chiara and Dr. Fehling, the rate of mortality has been much below the general average; but take the whole of the record, and even exclude the cases in which the stump was dropped in, and the recoveries fall far behind the average of the Säger operation in Germany. The general average mortality of all the cases is about 50 per cent., or about double that of the Säger cases; but exclude certain moribund and Veit-managed cases, and we lower the percentage of death to 46. Under the Müller modification about one-half of the operations were successful. Germany lost 10 women out of her first 28 Porro operations, and 12 out of her first 80 Säger operations. Austria saved 25 women under her first 38 Porro operations, or 65 per cent., but has not done so well as Germany in the Säger method, but somewhat better than her own Porro record, having saved 12 out of her first 17, or 70 per cent. Italy out of her first 65 cases saved 28 women, against the first 65 Säger operations of Germany with 54 women saved. We may fairly compute the mortality of the Porro operation as double that of the Säger on the general average, with a prospect of the former having a lower rate in the future. The Porro operations of 1885–87 show a diminishing fatality.

PUERPERAL LAPARO-CYSTECTOMY.

More closely allied to the Cæsarean operation than any other is the new exsective method of saving both mother and child in cases of advanced extra-uterine gestation. To accomplish the abdominal delivery of a living and viable extra-uterine fœtus, so as to save it

alive without the death of the mother, has long been the desire of the obstetric surgeon, but how to do it appeared to be a question of impossible solution until Dr. August Martin of Berlin on July 9, 1881, performed the first exsective operation, and demonstrated the possibility of removing by ligation and excision the whole abnormal growth, so as to escape the dangers of hemorrhage and septicæmia under placental exfoliation by not leaving any cyst or placenta to come away. Dr. Martin's operation was not as perfect in all points as some that have since been performed by other men who had cases of perhaps less difficulty; and in consequence of what he had to contend with and of the plan he adopted, the abdominal wound was many weeks in closing. But Dr. Martin was the pioneer in directing the way, and now the operation has been brought to great perfection, so that not only is life saved, but a more rapid convalescence is secured. Up to the time of Dr. Martin's operation there had been but 1 woman saved out of 20 operated upon by the former method of cystotomy, in which both cyst and placenta were either left intact or death was hastened by peeling off the latter from its attachments. With the exsective operation commenced a new era, and 5 out of 11 women have recovered. Of these cases, 7 were cystotomies, with 6 deaths, and 4 were cystectomies, without a death. These four were operated upon by Dr. Martin, Prof. J. Lazarewitch of Kharkof, Russia (now of St. Petersburg), Prof. August Breisky of Vienna, and Prof. Joseph Eastman of Indianapolis. Had the other six operators completely exsected the cyst and placenta, as was done by the two last, there would doubtless have been a much lower rate of mortality. The results of the four operations have been less fortunate as regards the children. The fœtus in Dr. Martin's case had an encephalocele, and did not respire on delivery, although the cord pulsated. In Prof. Lazarewitch's case the fœtus lived twenty-six days, had two attacks of convulsions, and died of inanition; the fœtus removed by Prof. Breisky lived nineteen days and died of an abscess near the umbilicus; and that of Prof. Eastman was alive and well when photographed at seventy-three days. The operation was performed on July 10, 1888, at eight months of gestation, and the patient made an excellent recovery. There will be great if not insurmountable difficulties to be met with in some of the forms of ectopic gestation; but the fact that all of the exsective operations have been thus far successful should be sufficient to encourage an obstetric surgeon to make trial of the same radical mode of operating. Already has this exsective plan of operating borne valuable fruit in Berlin and Copenhagen in its application to cases before the viable period, when the difficulties of the removal of the cyst and placenta, particularly at four or five months, will generally be found somewhat less than at eight or nine months.

In performing the operation care should be taken to open the cyst so

as not to injure the placenta, which is often found at the top of the sac. When the fœtus has been removed and the cyst is empty, the abdomen should be very carefully cleansed, so as to expose to view the attachments of the cyst to the intestines, omentum, and other contiguous parts. These should be tied and separated until the cyst is free above, when the tedious exsection of it and the placenta will commence. In Prof. Eastman's case, which he claims to have been a true Fallopian gestation, he was enabled to control the hemorrhage by clamping, under which mode of compression he was able to form a pedicle, which he cut off and then quilted in with a cobbler's stitch of iron-dyed silk, after which the clamp was removed and the abdomen irrigated with hot water.¹ There was very little shock under this operation, which was rapidly recovered from, the patient having her bowels moved on the third day and the drainage-tube removed on the fifth.

This new operation is made one of additional interest because of the fact that death has resulted in quite a number of instances from extra-uterine pregnancy in women of the higher walks of life. Unlike the Cæsarean operation, which is largely necessitated by poverty, it may be required by women in any social position, although it has rarely happened that the fœtus has developed to a viable age, because rupture and death have usually occurred. But still, there are those in this city who can recall to memory cases lost after the fœtus was viable that might at this day, in all probability, be saved like the Eastman case. I can recall to my recollection the cases of the wife of a banker, of a merchant, and of a physician who were all the subjects of ectopic gestation, and no doubt Drs. Thomas and Barker of New York could add several of the same positions to the record. It will not be advisable hereafter to await the death of the fœtus, and thus endanger the mother's life, since the possibility of saving both has been demonstrated and the method of operating explained by several obstetric surgeons who have become renowned by success.

SYMPHYSIOTOMY.

The fact that the pelvic symphyses become relaxed during gestation, and that in rare instances the pubic bones are found widely separated or even torn apart after severe labor, was known at a very early period in the history of medicine. Hippocrates, Galen, Avicenna, and others taught that the pelvic joints opened in labor from relaxation of their ligaments. As early as A. D. 1319, Jacques d'Ambroise, an anatomist of Paris, demonstrated it on the body of a woman who had been executed for infanticide a few days after delivery. The celebrated anatomist Vesalius taught it in 1564, and Severin Pineau wrote about

¹ *American Journal of Obstetrics*, September, 1888, pp. 929-931.

it in a work which he published in 1598, and which went through many successive editions, one of which is known to have fallen into the hands of Sigault of Angers, and was no doubt the cause of his turning special attention to the possibility of still wider opening the superior strait by the knife—a practicable feature that was hinted at by Pineau. The train of thought put in action by the reading of Pineau's book set Jean René Sigault, then a medical student, to investigating the subject practically, which he did very imperfectly upon the bodies of several women who had died in labor, his dissections having been made too long after death to give a full idea of the measure of pubic separation attainable in a living parturient woman. Had he known of the possible widening of the incision to two and a half inches, which he rated at one inch, he might, perhaps have received more attentive treatment at the hands of his judges.

Full of his subject, Sigault prepared a memoir upon it, which he sent to the Royal Academy of Surgery of Paris in December, 1768. Claiming for his operation a possibility of largely superseding the Cæsarean section, based upon a series of trials by which he could only show, as stated, an average pubic separation of an inch, his paper failed of accomplishing its purpose and he was looked upon as a visionary schemer. Not convinced, by any means, of erroneous reasoning, he made his plan the subject of his thesis at Angers in March, 1773, and subsequently defended it in Paris, where he applied for a license.

In 1773, M. Alphonse Leroy, professor of obstetrics in the École de Médecine of Paris, was led by the claims of Sigault to repeat his experiments, and, being fortunate at last in obtaining permission to operate on a Mrs. Brasseur soon after her death under the care of a midwife, he obtained a pubic separation into which he inserted his four knuckles, computed to measure $2\frac{1}{2}$ inches Fr. (about $2\frac{3}{4}$ inches Eng.) This made him a convert to the opinions of Sigault, whose cause he advocated, and with whom he divided the responsibilities and risks of the initial operation, and subsequently its honors.

In 1769, Mrs. Souchot, the wife of a soldier, deformed by rickets and measuring 4 feet $\frac{3}{4}$ inch (Eng.) in height, came under the care of M. Sigault in her first labor, who, finding her pelvis deformed, called in Dr. Piet, by whom she was delivered of a dead fœtus with a quite elongated head after a moderate degree of traction on its body. On May 2, 1771, assisted by Drs. Thevenot and Coutonly, he delivered her by the crotchet of a second fœtus. The third child was at eight months, and extracted by the crotchet with less difficulty. On Easter, 1775, Dr. Sigault had the advice and counsel of eleven accoucheurs, only one of whom, Thouret, was willing that he should operate by pubic section: the fœtus presented by the hands; the feet were brought down, and five or six accoucheurs pulled in succession until in three-

quarters of an hour the elongated head was brought through as at the first labor.

On September 30, 1777, Mrs. Souchot was in labor for the fifth time, and Dr. Sigault called in Prof. Leroy, who agreed to divide with him the responsibility of the proposed delivery by pubic section and assist him in it. Dr. Sigault accordingly operated on October 1st, and Prof. Leroy delivered by the presenting feet a living male child, the whole operation requiring not more than four or five minutes. The case was reported at the meeting of the Faculty of Medicine held on the evening of the day of operation, and a commission was appointed at the request of Dr. Sigault to examine the woman and watch the progress of her convalescence. The patient made a very slow recovery, and evidently, from the record, was in a disgusting condition, being deluged with urine from a wound made in the urethra by carrying the incision with the scalpel too far through the pubic arch. This accident was long overlooked, and the wound resulted in a urinary fistula which remained permanent and leaked except when she was in a sitting position. She became weak and emaciated, and from want of a proper appliance for keeping the pubic bones in juxtaposition they were many weeks in becoming reunited. At last she was well enough to be presented at a meeting of the Faculty of Medicine, and great honors were done to the operator and his assistant in the form of granting a decree and the presentation of medals: the dean, under instruction, petitioned for the granting of pensions from the Crown to the operator and patient; which was accordingly done. This bestowal of honors created much excitement in medical circles in Paris, and parties were formed in favor of and antagonistic to the new operation, which was praised overmuch on one side and somewhat underrated on the other.

The value of symphysiotomy as a substitute for the Cæsarcan section was far from being satisfactorily established by the result in the Souchot case. Drs. Sigault and Leroy claimed that the sacro-pubic diameter under instrumental measurement was established to be $2\frac{1}{2}$ inches Fr. (about $2\frac{3}{4}$ in. English), while Piet, Lauverjat, and Baudeloeque stated that there was a little to the left of the sacral promontory a working space of 3 inches for the bi-parietal diameter of $3\frac{1}{2}$ inches to pass through. Dr. Piet, who delivered the first child by the feet, stated that it was a larger one than the fifth, notwithstanding which he had experienced no greater difficulty in its extraction than he had had in the cases of a number of other women who had subsequently given birth to living children. The fact is, that Mrs. Souchot had an asymmetrical pelvis, with the sacral promontory deflected to the right, and the more open portion of the superior strait was to the left of it: her lower pelvis was ample for the birth of a fully-developed living child. Had her superior strait been a reniform, symmetrical one of $2\frac{3}{4}$ in. conj.

(Eng.), the rapid delivery of the fetus would have probably produced its death and have done injury to the sacro-iliac synchondroses. The case was by no means a typical one for a $2\frac{3}{4}$ -inch conjugate and a rapid delivery.

The public excitement produced by the result to mother and child under the initial operation occasioned the production of many critical monographs, and numerous tests were made upon the dead subject; which experiments, being usually tried too long after death, were entirely unreliable. Little attention was paid to the gains in the transverse and oblique diameters, the whole being directed to the small fraction that might be added to the true conjugate by each inch of pubic separation. The possibility of a wide separation without laceration of one or both sacro-iliac synchondroses was denied on the fallacious post-mortem experiments instituted upon the too rigid body; and it was not until the whole excitement had subsided that proper and satisfactory tests were made and relied upon. Drs. Girard of Paris and Ainsiaux of Liège, in 1800 and 1811 respectively, turned their attention to the test as made by Prof. Leroy in 1774 upon a woman recently dead in labor; and the latter obtained as high as 3 inches under the same circumstances, but failed to get more than $1\frac{1}{4}$ to $1\frac{1}{2}$ where the woman had been dead thirty-six, thirty-eight, forty-eight, or fifty-four hours. Dr. Girard had met with similar results.

Symphysiotomy was largely original with Sigault, so far as it was intended to be applied to the living woman, but it had been performed after death more than a century earlier. Dr. Jean V. C. Delacourvée of France, when practising in Warsaw in 1655, thus delivered a woman of forty-eight who had died after a labor of four days; and Prof. Jos. Jacques Plenck of Buda, Hungary, in 1766 repeated it for the liberation of a locked head, found in making a post-mortem Cæsarean section. It does not, however, appear to have entered into their minds that such an operation might be of value during the life of the subject. Pineau appears to have been the only one before Sigault who ever entertained such a thought, and he is believed to have been scared at the suggestion.

After Sigault's operation on Mrs. Souhot became known in Europe there were many to repeat the experiment, and in 1778 no fewer than eleven pubic sections were made in Prussia, France, Belgium, and Bavaria. Of the 11 women, 5 died, and all of the children perished but 1: in but 2 women was the sacro-pubic diameter as short as in the Souhot case, and both died. In Case 8, under Prof. Guerard of Düsseldorf, the measure was the same as in Mrs. Souhot's, and the feet likewise presented. Mark the contrast: one leg was pulled off; cranium opened; delivery partly by crotchet, and finally by the natural forces; operation and delivery eight hours; woman died in eleven days. Four

of the five women lost are noted as having died of gangrene of the genitalia; the cause of death in the fifth is not stated.

The eleventh and last case of 1778 was the fifth and last of Dr. Sigault's own operations, and occasioned as much unfavorable reflection as the first gave him reputation. Mrs. Vespres was a dwarf of thirty inches in height (about 2 feet 8 inches Eng.), with a seriously deformed pelvis, and had always walked upon crutches, who came under the observation of Dr. Sigault several months prior to her labor, and was decided by him to have a sacro-pubic measurement of 2 inches. When in labor on November 15, 1778, and examined under the disadvantages of a foot presentation by the fingers, the accoucheurs Coutonly and Lauverjat were of the opinion that she had $2\frac{1}{2}$ inches ($2\frac{3}{4}$ Eng.) in the conjugate, and on account of her asymmetrical contracted pelvis advised the Cæsarean section, believing that the pubic section must prove fatal to the fœtus. Being opposed in opinion by four other consultants, who sided with Sigault, she was delivered by him under symphysiotomy, after the employment of much force, of a moribund fœtus twenty inches in length. The mother died in great suffering five days later, and a careful autopsy showed a lacerated gangrenous perineum, a gangrenous vagina, and a separation of the ilium from the sacrum on the right side, with the periosteum detached; a partial mortification of the uterus and bladder, with a collection of sanious pus beneath the muscles of the left iliac fossa. The sacro-pubic measurement was found to be only 22 lines Fr. (about 2 inches Eng.).

The disastrous result of this attempt to make his pubic section a substitute for the Cæsarean operation in an extreme case of pelvic deformity checked the ardor of Sigault to such a degree that he subsequently declined to operate in a case having a $2\frac{3}{4}$ inch (Eng.) conjugate. In fact, he closed his career as an operator with this case, having saved 4 out of 5 women in thirteen months, and lost 4 out of 5 of their children.

In 1779 the failures of the first year began to affect the popularity of the operation, and the number fell off to five, under which all of the women and two of their children were saved. Prof. Alphonse Leroy took up the work abandoned by Sigault, and operated also five times—viz. twice each in 1779 and 1785, and once in 1804. He was more successful than his colleague, saving 4 women and 3 of their children. All of the cases had sacro-pubic measures above $2\frac{3}{4}$ in. (Eng.) but one, and that was fatal. Two were over 3 inches, one being $3\frac{1}{2}$ (Eng.), and a third was $2\frac{7}{8}$ in.

In 1780 there were 2 cases; in 1781, 3; and 1782, 1, in all Europe. In several subsequent years there was as high as 4, but there was a gradual decline until the operation died out for a time in 1858. Prior to its revival in Naples in 1866 there were 86 operations in eighty-eight

years, 35 of which were in the first decade. In 1781 the operation was introduced into Italy by Dr. Antonio Lavagnigno of Genoa, and into Naples in 1787 by Prof. Domenico Ferrara, who performed it at its present centre, the Hospital for Incurables. In 1818 it began an almost exclusive career in Naples, there having been since that date but four Italian operations performed in other cities, as far as I can ascertain, and but one in any other country (Holland, in 1830). This has arisen from the fact that there is an abundance of cases of pelvic deformity to be delivered, and that but 2 out of 27 women recovered after the Cæsarean operation between 1791 and 1875 in that city, although all of the children were extracted alive.

Distribution of Cases.—The 86 cases are credited to the following countries: viz. Italy, 39; France, 32; Holland, 6; Belgium, 4; Prussia, 2; Bavaria, 1; Spain, 1; and England, 1 = 86. The results of the operations are as follows: Women recovered, 57; died, 29; children extracted alive, 29; moribund, 7; dead, 45; condition not mentioned, 5. France saved 22 women out of 32, and lost 25 children; Italy saved 25 out of 39 women, and 15 of their children. A very marked contrast to these results will be shown when we come to record the operations performed in Naples since the revival of symphysiotomy in 1866.

Sigault performed the first pubic section with an ordinary long-pointed dissecting scalpel, hence his cutting one crus of the clitoris and the urethra. The probe-pointed bistoury next came into use for the section of the ligamentous portion after opening the *mous Veneris* with a scalpel. Then a short incision was made above the pubes, the bistoury passed down behind it, and the bones separated from below upward and within outward, as is done at the present day. The knife now in use is a strong, sickle-curved, probe-pointed bistoury, known as the *falcetta* of Galbiati, from its inventor, Prof. Gennaro Galbiati, who performed the operation of Sigault (1815–40) sixteen times, saving 8 women and 4 children, being one of the *aconcheurs* of the *Ospedale dei Incurabili* of Naples. The invention of the knife is much more to his credit than the murderous operation known as bi-pubiotomy, which he made trial of upon a dwarf $3\frac{1}{2}$ feet high on March 30, 1832, having a conjugate of only 1 inch. In order to widen the pelvis antero-posteriorly, so as to make room for the foetus to pass, he cut through the horizontal and descending rami of the ossa pubes subcutaneously with a chain saw. He succeeded in delivering the woman of a dead foetus, but in doing so severely cut the opposing soft parts with the sharp edges of the sawn bones, as may be readily inferred. The patient died in great suffering four days later of gangrene of the vulva, vagina, and adjacent tissues. Strange at it may appear, Dr. Nanzianti Ippolito tried the same expedient in the Hospital for Incurables in the winter

of 1842-43, with a similar result; and a recent writer has proposed the same operation.

As the rachitic pelvis is often asymmetrical, it is important to cut the symphysis according to its central line of direction. In several cases on record the knife was made to slice off a piece of one pubic bone, as was once done by Prof. Leroy in a subject that subsequently died of gangrene of the intrapelvic parts. The exsection of a bone-fragment retards the process of healing, as the piece may become carious and be discharged or require removal. In the oblique pelvis of Nægele, where one sacro-iliac symphysis is ankylosed, or in that of Robert, where both are so united, the operation is impracticable. It also is inapplicable in atrophy of one ilium with ankylosis due to early coxalgia, with consolidation of the hip-joint, the superior strait being D-shaped.

It is impossible now to secure a record of all the cases of symphysiotomy belonging to the first period—*i. e.* 1777 to 1858—although my record is as full as that of any collection of cases made at an early day. In 1806, Penehienati and Brugnone stated that there were 34 operations from 1777 to 1785, with 23 mothers and 11 children saved. Baudelocque collected 25 for the first five years: these we now have. In 1841, Dr. Fleetwood Churchill, with his usual inaccuracy, gave the number of operations as 49 and deaths at 16, when he should have found 78, with 26 deaths. Although there must have been an abundance of material in Naples for the operation, it fell off to such a degree in numbers that in the thirty years from 1828 to 1858 there were only 19 cases, 11 of which were under one and the same operator.

I have thus carefully drawn up the history of the rise and decline of symphysiotomy in what may be denominated its *first period*, and have not failed to record the measure of its fatality to the women operated on, which is only exceeded by that of the hastily-delivered children. There is nothing in the results attained, we should think, to induce any one to revive the operation in the hope of largely reducing the proportion of deaths in both mothers and children, and it required even more boldness and self-confidence to do this than it did for Dr. Sigault to perform the first operation in the hope of saving Mrs. Souchot and her fœtus. Still, it was done under Professors Morisani and Novi, and we have now to record the marvellous revolution in results attained by the operation under its second period.

Second Period.—In the last decade of symphysiotomy in Naples, closing with 1858, the operations amounted to only 5, saving 4 women and 3 children. It is generally supposed that in the next eight years preceding the “resurrection” of the operation, as Prof. Mangiagalli of Catania calls it, there were no cases in all Italy; but my friend and correspondent, the late Dr. Cesare Belluzzi of Bologna, wrote me that

he had operated in 1863 and 1865, with fatal results to the two women, but saving the children. The first died of pneumonia, with gangrene of the symphysis pubis, in thirteen days, and the second of peritonitis, having an uninjured pelvis, in six days. There were then in all Italy 7 operations in twenty years prior to January 5, 1866, and there have been no fewer than 70 in the twenty years commencing with that date. The 7 operations saved 4 women and 5 children, and the 70, 53 women and 55 children, 40 women and 41 children having been saved out of the first 50 in the Ospedale dei Incurabili of Naples between the date given and the close of 1880. These 50 operations, saving 80 per cent. of the women and 82 per cent. of the children, fairly represent the possibilities of symphysiotomy when judiciously undertaken and skilfully performed.

In view of the former record of the Sigaultian operation and its reputation as a surgical failure, its present local status appears almost incredible. Still, here are the facts, taken for me from the hospital record and attested by Profs. Morisani and Novi in their monographs on the operation. As in the Sænger Cæsarean operation, so in this, there is a remarkable connection between fœtal and maternal mortality—not so marked in cases of pubic section as in the Cæsarean, but still there is the relative diminution of death-rate. There is also this that does not so readily appear: the woman is less injured than formerly by pelvic strain; has a better and more rapid convalescence, less lameness, and better subsequent health. Under the original system, of turning and rapidly delivering the fœtus, not only was the life of the child endangered by the traction, but the sudden opening of the pelvis strained the sacro-iliac synchondroses, giving rise to serious if not fatal results; hence inflammations ending in gangrenous destruction of pelvic organs and tissues and the formation of abscesses. By the improved method, according to the direction of Morisani, the forceps will only be required in about one-fourth of the vertex cases, and the others should be permitted to deliver themselves; turning ought to be avoided where the head can be made to engage in the superior strait. Of the first 50 cases since 1866, 45 were presentations of the vertex, and 41 of the children were delivered alive. The other 5 deliveries were by the feet, and every fœtus was lost; 3 were breech presentations, and 2 were of the right shoulder.

In the next tabular record (18 cases) of the same hospital we find marked departures from the above carefully-considered rules, and an increase of the death-rate from 20 to over 40 per cent. in the women. There were 17 presentations of the vertex, and 1 of the feet; 13 of the former were delivered by the forceps, with the loss of 7 women and 1 child; 2 vertex cases were delivered by turning, losing 1 woman and both children, and 2 children were destroyed by instruments, 1

before and the other after the operation. Under the head of "observations" Prof. Morisani has marked opposite 3 cases "operation unjustifiable." If the fœtus is hurriedly drawn into the world, it is safer for it to be extracted with the forceps than by the feet; but it is far safer for the mother, if possible, to be delivered slowly and by her own natural forces than by either. The chief danger to the woman appears to lie in a *rapid* forcible extension of the sacro-iliac ligaments; the same accomplished by slow degrees is attended with less risk.

Since the revival of symphysiotomy in Naples twenty-two years ago there have been 76 operations in that city, and 1 in Asti, under which 58 women and 59 children were saved. These with the cases (86) of the first period make 163 operations, with 115 women and 88 children saved; 115 of the entire number belonging to Italy alone, and 48 to the rest of Europe.

In 1867, Prof. Enrico Jacolucci of Naples, who performed the last three operations of the first period, proposed a combination between the introduction of premature labor and the operation of pubic section in one class of extremely deformed cases, and between the same and craniotomy or cephalotripsy in another and still more deformed class. Acting upon these suggestions, Prof. Novi has several times, to avoid the Cæsarean section with its great fatality in Naples, combined symphysiotomy and craniotomy; and Prof. Morisani relates a very remarkable experience in the association of the introduction of premature labor with section of the pubes. Prof. Novi induced labor in the seventh month where the conjugate measured 54 mill. ($2\frac{1}{8}$ in. Eng.). Unfortunately, it was a shoulder presentation, and the fœtus, being delivered by turning, lived but an hour: the woman recovered in fifty days. In a second case the woman fell in labor at full term, having a sacro-pubic measurement of 49 mill. (less than 2 in. Eng.), and the fœtus was dead. Here the symphysis was opened, the head perforated and crushed, and delivery then completed. The woman recovered in forty-two days.

The case of Prof. Morisani is one of unusual interest and requires a more detailed statement. Lucia Esposito, a rachitic dwarf, aged twenty years, 3 feet $7\frac{3}{4}$ inches high, conjugate $2\frac{3}{16}$ inches ($5\frac{1}{2}$ cm.) entered the Clinica Ostetricia on May 15, 1880, in the seventh month of her pregnancy. The extent of her deformity being ascertained, it was determined to bring on labor in the first week of the eighth month. This was done on June 9th, and on the 11th, when sufficiently advanced, the pubes was opened. Head presented in first position of vertex; began to descend, passed into the pelvic cavity, was delayed at the perineum, and finally escaped by the vulva. Fœtus began to breathe regularly; it measured $15\frac{3}{4}$ inches long and weighed $4\frac{1}{4}$ pounds; occipito-frontal diameter, $3\frac{1}{2}$ inches; occipito-mental, $4\frac{3}{4}$; biparietal, 3 inches (7.5 cm.); and bitemporal, $2\frac{3}{8}$ inches. Child when three days old was

sent to a foundling hospital. The wound was dressed with a compress kept moist by a drainage-tube leading from a vessel of hæmostatic water, and by the end of a week the pelvis was fixed in an immovable apparatus with an opening over the wound. Union was complete in thirty-four days, and in forty days she left her bed, being soon afterward ready to be presented at the clinic, having no pain or inconvenience in walking. Photographic pictures of this woman, presented by me to the College of Physicians of Philadelphia, fully attest the character of her deformity.

Symphysiotomy cannot take the place of the Cæsarean section and its modifications except to a very limited extent. It has a range of only a fraction over half an inch. By common consent of the best operators the minimum conjugate for safe delivery has been fixed at 67 millimeters, or $2\frac{5}{8}$ inches, and the maximum in 68 cases in Naples was 81 mill. or $3\frac{3}{16}$ inches. There were 2 operations at 61 mill. ($2\frac{7}{16}$ in.), 1 at 66, 18 at 67, 1 at 68, 4 at 69 ($2\frac{3}{4}$ in.), 20 at 74 ($2\frac{1}{2}$ in.), and 20 at 81 mill. Of the first 50 cases there were 10 deaths—viz. 5 out of 15 having a conjugate of $2\frac{5}{8}$ inches; 4 out of 15 where it measured $2\frac{1}{2}$ in.; and only 1 out of 13, where the c. v. was $3\frac{3}{16}$ inches. In the second record, of 18 cases with 8 deaths, there seems to have been little connection between the measure of deformity and rate of mortality—c. v. 67 mill., 3 cases, no death; c. v. 68 mill., 1 fatal; c. v. 74 mill., 5, deaths 2; c. v. 81 mill., 7 cases, 4 deaths.

CAUSES OF DEATH.—These are quite different from those under the first period: Metro-peritonitis, 3—1 after four days' labor; septic metro-peritonitis, 1; peritonitis, 2; iliac phlegmon and metro-peritonitis, 1; endocarditis in twenty-four days, 1; endocarditis and diphtheritic vaginitis, 1; pelvic tumor and long labor, 1; hemorrhage from uterine inertia, 1; puerperal infection, parametritis, pelvic abscess, tetanus, 1; gangrenous endometritis, 1; exhaustion from long labor and repeated applications of the forceps, 1; not stated, 4 = 18.

METHOD OF OPERATING.—Cleanse the genitalia and vagina with a wash of bichloride of mercury, 1 part to 2000; shave the mons Veneris; ascertain the centre of the symphysis pubis by finding the spines of the ossa pubes and the intermediate point between them; make a vertical incision of about an inch in length, down to the suprapubic centre; introduce the blade of a Galbiati knife behind the symphysis and force down its probe-pointed end until it can be felt under the pubic arch; then raise the handle and cut from below upward and from within outward until the bones give way and begin to separate. If the head presents, allow the woman to deliver herself if she can; if too feeble in power, aid gently with a Davis or a Sawyer forceps, as these have blades which occupy but little space when applied. After the delivery is accomplished sew up the suprapubic wound and bring

the separated pubic bones together by long strips of adhesive plaster raised from the mons Veneris by a roll of bandage placed upon either side. When the wound is healed put on an immovable apparatus for fixing the pelvis. Treat the patient aseptically, as after an ordinary parturition, for the purpose of avoiding metro-peritonitis, the most frequent cause of death.

Symphysiotomy has never been performed in the United States, but there is no reason why it should not be as an alternate to craniotomy. Pelvimetry carefully performed may show that a pelvis is just a little too small for the passage of a living child in a woman already in labor. Craniotomy may be performed without very great risk, as the head will require but a moderate reduction in size to enable it to pass. The forceps does not answer, as it cannot make a sufficient reduction and the head is strongly ossified. The experience under skilled hands in Naples shows that in just such cases symphysiotomic delivery resulted in death from metro-peritonitis in only 1 subject out of 13, a woman of forty who had been four days in labor. Is there not an occasional ease in our country where the value of the life of the fœtus is worth this degree of risk? A justo-minor pelvis may be found in a lady who is very anxious for the birth of a living child: she is too far advanced in gestation to be delivered prematurely; in fact, may be already in labor. Will you destroy her fœtus or open her pubes subcutaneously and let her deliver herself? Dr. Robert Barnes of London claims that the women are crippled for life by the operation. Prof. Ottavio Morisani, who is a much higher authority, has written me quite the opposite. He says: "The immovable dressing secured the firm union of the symphysis pubis in all the cases that recovered," and "that the women had good health after the operation;" that "phlegmasia dolens did not occur in any of the 50 women," and that vesico-vaginal fistula occurred in but 1 case, which was easily cured by an operation. "The separation of the pubes in these 50 cases amounted to 50 mill. (about 2 inches), which was obtained without any effort and without producing any lesion of the sacro-iliac synchondroses." The operation is a less formidable one to a woman than gastro-hysterotomy, which does not seem to be justified under the amount of deformity named. In the Porro and Sänger operations of Europe the sacro-pubic diameter has generally been computed at $2\frac{1}{2}$, $2\frac{1}{4}$ inches, or less, and the degree of pelvic deformity has but little to do with the final result of the case. But with symphysiotomy, on the contrary, much must depend upon the length of the true conjugate, and with proper care and skill the risk will diminish as the working space in the pelvis increases. The greater the disproportion between the size of the fœtal head and pelvis, the greater must be the strain upon the sacro-iliac connections, and *vice versa*. Hence the vital importance of making an accurate measure-

ment of the pelvis before deciding upon the practicability and prospective risk of the operation. As a very small woman may bear a large fœtus with an overgrown head, there is always an additional difficulty to be considered in the fact that the size of the head cannot be estimated before birth. The prognosis, then, must have always an element of uncertainty in it, making it all-important not to risk an operation in a case with a very small conjugate. If the operation is ever to be tried in the United States as a substitute for craniotomy, the initial case should be one that gives a fair prospect of success to mother and child. I heard an accoucheur say recently that he had delivered twenty-four children under craniotomy. No doubt in this number there must have been one or more cases adapted to delivery under the pubic section with safety. I am confident that I met with such cases in the hands of distinguished accoucheurs years ago when there was less conscientiousness about craniotomic infanticide than there is now, and apparently more demand for it in the less prevalence of the employment of well-fitting forceps. There are physicians who ease their consciences by never performing craniotomy until after the fœtus is dead: are they entirely guiltless, then? Is it not the duty of such men to try to save both child and mother if this can be effected by the Singer operation or the method devised by Sigault and rendered much less fatal by Morisani?

Symphysiotomy is not as simple an operation as many might suppose, and ought to be carefully studied upon the dead subject. The tissues are softer and most easily cut, upon the parturient woman or one that has died in or soon after labor. The Galbiati knife has been introduced into our country, and I know of several accoucheurs who have it, and who may make a trial of the operation when a suitable case presents itself. One woman in Ohio now rejoices in a living child, saved for her in hospital by the improved Cæsarean section after the loss of three children under craniotomy. In a proper case this may be done under the pubic section with the same result.

(For many historical facts of the early days of symphysiotomy I am indebted to the valuable collection of special monographs by Sigault, Leroy, Piet, Lanverjat, Baudeloeque, and many others in the Lewis Library of the College of Physicians of Philadelphia.)

LAPARO-ELYTROTOMY.

Until within the last six years, and most decidedly within the last two, in which German, Austrian, American, and other successes have taught a different lesson, the Cæsarean operation in its true type was regarded by many as the most fatal in surgery, and, as opening the peritoneal and uterine cavities was looked upon as lying at the founda-

tion of the risk, plans of delivery under the knife by which both of these dangerous exposures might be avoided were at different times devised during the last eighty years. As it was long known to anatomists that the cervix uteri might be reached from the lower part of the abdomen beneath the peritoneum, it became a question for consideration whether delivery might not be accomplished through the flank and the vaginal wall subperitoneally.

The first who is known to have conceived of this idea, although he never tested it in practice, was Prof. Johann Christian Gottfried Jörg of Leipzig, whose proposition dates back to 1806. The main idea of this German obstetrician was to avoid the danger of opening the body of the uterus by incision, which he believed to be the great *fons et origo mali*; and to do this he proposed to open the abdomen through the linea alba, so as to reach the vagina, and then incise it, extending the vaginal opening, if space should require it, into the cervix. Cervico-vaginal lacerations permitting the fœtus to escape into the abdominal cavity have not been uncommon, and perhaps this has been the least fatal form of uterine rupture. One of these accidents came under the observation of Prof. Jörg, and led him to think of delivery in the same direction by incision. Had he used his knife at the point and in the manner proposed, he would have discovered that an accidental laceration was less provocative of fatal hemorrhage than a clean incision.

The second to enter upon a somewhat similar line of thought, and influenced to do so by the teaching of Jörg, was Prof. Ferdinand Franz Angust von Ritgen of Giessen, who in 1820 proposed an improved method of operating which he learned in part from the subperitoneal method of ligating the external iliac artery. His plan was to make a curved incision in the abdomen on the right side from the region of the crest of the ilium down to a point near the symphysis pubis, at a distance of an inch from the bones, through the skin and muscles to the peritoneum. This membrane was then to be lifted from the iliac fossa, the vagina brought into view, and an opening made into it for the delivery of the fœtus: he also proposed to follow the plan of Jörg in enlarging the opening of the vagina by incising the cervix uteri to gain room for the passage of the fœtus if such should be required.

In putting this plan into practice in 1825, Prof. Jörg made trial in a case of malacosteon affecting a multipara, and progressed satisfactorily until he attempted to enlarge his vaginal incision (which he had made an inch and a half long with safety) toward the cervix by the knife, when such a violent hemorrhage was provoked that he was forced to desist and to deliver the woman by the Cæsarean operation. The child was saved, but death resulted in the woman from hemorrhage in fifty-eight hours coming from the gaping uterine incision, the uterus having been relaxed by inertia to a length of eleven inches.

Failing in this attempt to perform a true laparo-elytrotomy by reason of not opening the vagina by laceration, Prof. Ritgen did not learn that the vagina alone would provide a sufficient opening for the passage of a fœtus, but conceived the idea that to gain space it would be necessary to split the anterior lip of the uterus its entire length. It appears singular to us now, that these two men failed to make the proper application of what they were taught by the case of rupture, and to tear the vagina open to avoid hemorrhage.

The third proposition was made in the thesis of Auguste Baudelocque — later in life Prof. Louis Auguste Baudelocque of Paris — which he presented before the medical faculty in 1823. In this he proposed to open the abdomen in the linea semilunaris down to the peritoneum, the incision to extend from a point opposite the umbilicus down to within two inches of the pubes. The peritoneum was then to be separated from the iliac fossa by a finger entered at the lower angle of the wound and worked outward and upward. One assistant was then to hold up the peritoneum, and another to fix the uterus, while the operator was to feel for the arteries surrounding the vagina; to tie them at both ends; then to force out the anterior vaginal wall by means of a hand in the vagina, carrying it through the wound, when he was to incise it to the extent of four and a half inches, avoiding the part near the cervix. The delivery was then to be left to nature, or, if requisite, the forceps was to be employed.

Prof. Baudelocque operated twice, but was in neither case able to carry out his proposed plan. The date of his first experiment has not been given. The woman was a rachitic dwarf, thirty-nine inches high, with a conjugate of $1\frac{3}{4}$ inches. On puncturing her vagina to commence the incision in it he started such a violent hemorrhage that he was forced to desist, tampon the wound with sponges, and complete the delivery by the Cæsarean section: the child was lost, and the woman bled from both vaginal and uterine wounds until she died.

His second trial was on May 6, 1843, the subject being affected with eclampsia and having a conjugate of nearly 4 inches, the child also proving to be dead. Fearing a repetition of his first experience, and not knowing the value of laceration over incision as a means of avoiding the vaginal hemorrhage, he passed a needle around the left external iliac artery (this operation, as well as the former one, being on that side); but just at this point the assistant unfortunately let drop the peritoneum; he could not for a moment see the needle, the internal iliac was pricked, and he was forced to ligate the primitive iliac. He then incised the vagina as proposed in his thesis, and turned and delivered the dead fœtus: the woman died in seventy-four hours of septic peritonitis. This operation appears to have been entirely unjustifiable, as the fœtus was dead and the pelvis not deformed. If laparo-elytrot-

omy was possible, craniotomy should equally have been on the dead fœtus.

The fourth proposition was made by Prof. Philip S. Physick of Philadelphia in 1822 to Dr. William E. Horner, the anatomist, who sent it in 1824 in a letter to Dr. William P. Dewees, by whom it was introduced into his work on obstetrics, then passing through the press in its first edition. The plan proposed was to open the abdomen by a transverse incision above the pubes; to separate by careful dissection the peritoneum reflected over the bladder, which viscus was to be somewhat distended, so as to expose the cervix uteri where it is not covered by this membrane; and then to incise the cervix so as to give exit to the fœtus. Fortunately for the credit of the originator, his plan was never put into practice, as it would have greatly endangered the integrity of the peritoneum, and have necessitated the opening not only of the cervix, but of the vagina at dangerously vascular points, and have no doubt ended fatally to the patient experimented upon.

The fifth proposition was that of Prof. Sir Charles Bell of Edinburgh, introduced in 1837 into his *Institutes of Surgery*, a manual prepared for the students who attended his medical lectures. His plan of reaching the vagina was that of Ritgen, but here he made the important change that it was not then to be opened, except very slightly, by incision. His directions are these: "Make a small incision; introduce the finger; dilate slowly; imitate in this the natural labor; there would be neither pain nor danger by delay" (p. 342). He made a similar proposition with regard to opening the uterus in the Cæsarean operation some years earlier, and evidently held the opinion that the uterine or vaginal tissue could be dilated from a small incision to a large opening as the os uteri dilates: he says nothing of tearing the parts, as was done at a later period by Thomas. It has been much more recently shown that an accidental trocar-puncture of a gravid uterus will very soon dilate into quite a large orifice.

Dr. Francesco Cianflone of Naples repeated the operation of Baudeloque in 1856, and lost his patient in twenty-four hours, but saved the fœtus. This was the only operation of the kind in Italy. Dr. Cianflone was one not to be deterred by a previous failure in other hands, as shown by his repetition of the murderous operation of bi-pubiotomy as devised by Galbiati, and with a like fatality, in 1854.

We come now to the revival of the operation in 1870, and its successful performance without hemorrhage by Prof. Theodore Gaillard Thomas of New York, who, strange to say, was not aware until after his initial trial that various attempts had been made to accomplish the same end in the preceding forty-five years. Prof. Thomas, regarding the Cæsarean section as "the most dangerous operation in surgery," and knowing well the anatomical relations of the peritoneum, uterus,

vagina, lower abdomen, and pelvis, conceived the idea of avoiding what he believed to be the chief dangers of the old method by a subperitoneal entrance of the vagina and a delivery of the fœtus through the os uteri, a vaginal laceration, and the lower abdomen, as by the combined methods, unknown to him, of Ritgen and, in a measure, of Bell. He tested his plan upon the bodies of three dead women, one of whom was pregnant and had nearly reached the full term of gestation. Finding from the last case that the operation presented no material difficulties, he substituted it for the Cæsarean operation in a case to which he was called about a month later in the spring of 1870. The subject to be operated upon was in a hopeless condition from pneumonia and in a moribund state, while the fœtus was premature, and, as was shown upon delivery, not in a condition to live: both survived the operation about an hour. The whole time consumed in operating was about thirty-five minutes. Thus was accomplished without arterial ligation or severe vaginal hemorrhage a method of delivery which all his predecessors had failed in when making the attempt.

Method of Operating.—This has been now fully established by the work of five American operators, who have had collectively 7 successful cases, and may be stated as follows: The operating-room is to be warmed to a temperature of 75° to 80° Fahr., and it may be carbolized if thought desirable, but the use of spray during the operation is generally considered objectionable. The patient is to have her rectum and bladder well emptied, and her labor is to be so far advanced that her os uteri shall be either fully dilated or easily dilatable. The instruments, ligatures, and sponges to be used are all to be carbolized, the abdomen washed with warm water and soap, then with ether, and then with dilute carbolic acid or bichloride solution, and the vagina irrigated as already directed for the antiseptic Cæsarean operation. The operator is to stand on the right of the woman, and make his incision on the right of her abdomen, parallel with and a little more than an inch above Poupart's ligament, his chief assistant on her other side at the same time drawing up the skin of the abdomen to make it tense. The incision is to commence at a point one and three-quarter inches above and to the outside of the spine of the os pubis, and to be carried in a slightly curved direction upward and outward to a point the same distance above the anterior superior spinous process of the ilium, the wound measuring about five inches in length. The muscles being carefully cut through and the peritoneum exposed, the edges of the wound are to be secured against bleeding by the use of compressing-forceps, the chief vessel to be secured being the superficial epigastric artery. The peritoneum is to be carefully separated from the tissues overlying it to the full length of the incision, and is then to be peeled from the fascia transversalis and fascia iliaca, and lifted up until the

vagina is brought into view near its uterine connection. It must here be borne in mind that in a case of extreme pelvic stenosis almost the whole internal operation is performed above the superior strait, into which the foetal head cannot enter, the uterus, bladder, and expanded vagina being forced upward for want of accommodating space.

The second assistant, who stands to the left of the operator, now introduces his hands, guarded by a warm napkin so as to prevent slipping, and lifts up the peritoneum away from the iliac fossa with the superincumbent intestines, so as to open the parts to the eye of the operator, while the first assistant, opposite to him, draws the uterus upward and to the left side, so that the right side of the vagina shall be brought to view. The third assistant, at the left hip of the woman, holds a female catheter in the bladder as an indicator and to lift the viscus from the vagina, while the operator, with a round-ended wooden instrument, or, better still, with his fingers, forces up the vaginal wall into the wound, the sense of touch enabling him to avoid important arteries and large veins in making the vaginal puncture.

As the attempts to open the vagina with a knife proved so disastrous in the hands of Baudelocque and Ritgen, it has been proposed by Dr. Garrigues of New York to open by canterization instead of incision; but this precaution has not been found necessary. The safest point for puncturing is about one and a half inches anterior to the cervix, and by the use of a round-pointed conical piercer and a pair of large dilators, such as are used for the cervix uteri, all cutting may be avoided if thought dangerous. In general, a very small puncture, and the index finger forced through immediately after it is made, will not be attended with any serious loss of blood. A second index finger is next to be forced through, and the two are to be forcibly separated, so as to lacerate the vaginal wall extensively for the passage of the foetus, care being exercised not to tear too near the neck of the bladder. The point selected for making the puncture is chosen with a view to avoid the ureter and the larger vaginal blood-vessels.

The catheter is next to be removed, and the membranes, if intact, ruptured: the first assistant tilts over the fundus uteri to the left and backward, so as to cause the cervix to rise toward the groin, while the operator with his finger in the os lifts it in the same direction. The foetus may now be allowed to escape by the contractile force of the uterus, or it may be requisite to deliver by version or the forceps, and, if dead, by other instruments. The placenta is to be expelled by compression and delivered through the wound.

When the uterus is fully contracted the tract through which delivery has been accomplished should be thoroughly cleansed by irrigating with warm carbolized water, the fluid escaping by the vagina; and particular care should be taken after a dead, and specially a putrid, foetus has been

removed. In case of hemorrhage from torn vessels ligation should be used; but if this is impracticable, cauterization may be accomplished through a non-conducting speculum: persulphate of iron may also be applied *per vaginam*. To test the soundness of the bladder, warm milk may be injected into it, as suggested by Dr. Garrigues, the color of the fluid indicating any tear in its escape—an important examination when it is considered that this viscus has been five times lacerated and once cut with the scissors in fourteen operations. Skill may, but will not always, prevent the tearing of the bladder, as it is impossible to regulate the measure of distension which the passage of the head will produce. When a rupture is discovered by the milk-test it should at once be sutured and a catheter worn until the wound is healed.

The last step in the operation is the closure of the abdominal wound, which is done by interrupted sutures of carbolized silk, as after ovariectomy, and the parts dressed antiseptically. The wound will only partially close by the first intention, and for this reason some operators have preferred to leave its lower angle open or to use an abdomino-vaginal drainage-tube. The time required in recovery has varied from two weeks to nine, the average being five weeks.

The directions given have been for a right-side operation, which was at one time thought to be a necessity in view of the position of the rectum—a matter not of any consequence, as shown by the fact that three left-side operations have been performed, and it so happened that the bladder was not torn in one of them. The possibility of a second operation has also been settled by these left-side cases. Women may be deformed in such a way that a left-side operation may be preferable or even imperative, as, for example, where a coxalgic ankylosis has fixed the right thigh across the side of the abdomen and shut up the groin.

Laparo-elytrotomy is not a difficult operation if in the hands of one who is conversant with the anatomy of the parts involved and knows by the eye and touch the tissues to be encountered. The normal relations of the ureters, vagina, and uterus should be known, but much reliance cannot be placed upon them in cases of extreme pelvic deformity where these viscera are greatly displaced. The time required in an operation must vary in accordance with the slow or rapid progress of the labor; the delivery has been accomplished in ten minutes, but may take the greater part of an hour if the os uteri should prove not to be easily dilatable. In some cases of pelvic deformity the cervix remains obstinately rigid and but slightly dilated for days together, and Barnes' dilators may not be available because of the stenosis: dilating the os after the incision may greatly retard the delivery.

The applicability of laparo-elytrotomy is much more limited than that of the Cæsarean section, as the integrity of the cervix is an absolute essential of success, for the fœtus must pass through it. This

limitation is a marked feature in the American Cæsarean record, as fully one-third of the 175 cases were not proper subjects for laparo-elytrotomy. In European subjects, in whom pelvic deformities are almost the only recognized obstacle to delivery, this objection would not avail. For reasons not altogether understood, the successes of Brooklyn and New York in 1875 and 1877 did not for a period of eight years induce any Continental operator to make trial of the sub-peritoneal operation. Possibly, the Porro method, which came into notice at the same time, drew away whatever attention it might otherwise have attracted.

Statistical Record.—Laparo-elytrotomy since its revival and vital improvement under Prof. Thomas, eighteen years ago, has been performed 14 times, of which number 11 cases belong to the United States, 2 to England, and 1 (in 1885) to France. Of the American operations, 3 were performed in New York City, 6 in Brooklyn, 1 in Cincinnati, and 1 in Newport, Rhode Island. Prof. Thomas has had 2 cases; Prof. A. J. C. Skene of Brooklyn, 4; Prof. Charles Jewett of the same city, 2; and Drs. T. W. Hime of Sheffield, England, Arthur W. Edis of London, Walter R. Gillette of New York, N. P. Dandridge of Cincinnati, J. Pouillet of Lyons, and W. Duncan McKim of Newport, each 1. 7 of the women recovered; 5 children were dead, and 1 moribund on delivery; 1 lived eighteen days; and 7 more are recorded as saved. Of the 7 fatal cases, 1 was operated upon when in a dying state, and lived only an hour; a second had a feeble pulse of 130, and had been forty-eight hours in labor, in which craniotomy had been attempted; she died of shock in seven hours; a third (Dr. Hime's) had cancer of the recto-vaginal septum, was addicted to habits of intemperance, and had been in her bed for eleven weeks: she died violently delirious in two hours; a fourth (under Dr. Edis) was in bad health and had œdema of her lower extremities: she died in forty hours; a sixth had been a week in labor, and died of septicæmia in seventy hours; and the seventh (Dr. Pouillet's) was operated upon when in a favorable condition, but died of peritonitis on the eighth day. The children of the three European cases all lived.

The seven women who recovered were in labor, respectively, eight hours, eleven hours, sixteen hours, twenty-two hours, twenty-nine hours, four days, and a week; and all of their children were living except that of the last, which had been destroyed by craniotomy and was putrid. Prof. Skene saved 3 women and 4 children by his four operations. Of the 14 cases, 3 were hopeless when operated on, and 6 of the remainder quite unfavorable; still, one-half of the women were saved.

Prof. Thomas, although not the original projector of laparo-elytrotomy, was the originator of the scheme that robbed it of the fatality

which had always attended its performance in the hands of his predecessors, and gave it the value that it now possesses. The key to success certainly belongs to him, and not to Sir Charles Bell, whose language cannot be made to teach vaginal *laceration* when he evidently intended to advise *slow dilatation*, as he had in 1813 in reference to the uterus as a substitute for the incision in the Cæsarean operation. He had a theory to put into practice, a trial of which might possibly have taught the feasibility of laceration; but to tear for the purpose of avoiding hemorrhage was evidently not the idea that actuated him. If by an accident in an ovariectomy you puncture the wall of a gravid uterus with the trocar in the later months of pregnancy, you may see, as Prof. Byford of Chicago did, the hole you have made dilate under uterine contraction to the size of a dollar in a few minutes. Sir Charles Bell assisted his brother John in a Cæsarean operation in the year 1800, and noticed that his initial incision in the uterus immediately opened to almost a round hole. The woman died of hemorrhage, and on autopsy it was found that the uterus had contracted in all parts except in the line of incision, which appeared to extend from fundus to cervix; the wound gaped open and had everted edges. Strange that his thoughts did not suggest the use of sutures, but they did not: his mind reverted to what he witnessed in the operation as the effect of muscular action in converting a straight cut into a round opening, and he conceived the idea that the uterus might be opened by puncture and a gradual manual dilatation so as to admit of the passage of the foetus. What he taught in 1837 was simply the application of this idea to the vagina.

Prof. Thomas acted upon two well-known facts—viz.: 1, that lacerated wounds bleed but little in comparison with incised wounds in the same location or tissue; and 2, that accidental cervico-vaginal laceration in labor, although largely fatal, even after the foetus has been delivered *per vias naturales*, owes its fatality not so much to hemorrhage as to shock and exhaustion; and it is well known also that this kind of laceration is, of all the forms of rupture in labor, the least mortal in its results, which may be attributed largely to its natural drainage.

Laparo-elytrotomy has been greatly overshadowed by the improved Cæsarean operation, but for which it might have been much more thoroughly tested. It is certainly less fatal than the old operation, and possibly less than the Porro method. It would require many more cases to compare its value with that of Säger's operation.

PUERPERAL INFECTION.

By HENRY J. GARRIGUES, A. M., M. D.,

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HAVING been requested to write on Puerperal Infection, the first difficulty encountered was to define the limits of the subject. The view we now take of the dangerous disease which used to ravage lying-in hospitals, which yet is met with occasionally, and which is commonly known as puerperal fever—namely, that it is due to the entrance of microbes into the body of the puerperal woman—is so new that its foundation was only laid in the decade from 1870 to 1880 by the researches and experiments of Mayrhofer, Recklinghausen, Waldeyer, Orth, Heiberg, Haussmann, Spillmann, Kehler, Hugh Miller, Pasteur, and Doléris.¹ Since then the question of microbes, their nature, their effect, their relation to certain diseases, and especially to the occurrences in childbed, have been considerably developed. Being in the middle of this period of investigation, we run a risk of being carried too far by the enthusiasm engendered by the light that after so many centuries of vain speculation has been thrown on the mysteries of that dread disease which used to surround childbearing with such gloomy apprehensions.

I think it can be looked upon as a well-established scientific fact that the more serious affections of childbed are due directly or indirectly to microbes, but, so far as I know, it is not yet settled whether the more benign forms of fever and inflammation that affect the puerpera have the same source or not. Still, the domain of the microbic theory seems to be widening more and more. Even insanity is by some attributed to sepsis.²

¹ J. A. Doléris: *La Fièvre puerpérale et les Organismes inférieurs*, Paris, 1880, pp. 45-49.

² Hansen has examined 49 cases of psychic disturbance occurring during the puerperium: in 42 of them he found septic infection, in various degrees, present. He concludes that the majority of cases of puerperal psychoses are caused by septic infection or eclampsia: when in the early weeks of the puerperal period a psychosis characterized by acute hallucinations develops without a previous eclampsia, the diagnosis of puerperal septic infection is justified, even in the absence of fever and other symptoms ordinarily present in infection (*Am. Journ. Med. Sci.*, Nov., 1888, p. 547, from *Zeitschr. für Geburtshülfe und Gynäkologie*).

Under these circumstances I have agreed with the Editor that I should treat of all inflammatory conditions except the eruptive fevers, and leave the non-inflammatory affections of the nervous system, such as tetanus, tetany, and insanity, to another writer. In my own opinion what is thus left to me is so intimately connected that it is not possible to draw the line of demarkation within its limits; and yet this entails the essential unity of so different conditions as a swelling of a broad ligament referable to a tear of the cervix, or an inflamed inguinal gland affected by a lymph-vessel which connects it with an abrasion on the vulva—slight affections that, with proper treatment, in the vast majority will pass off in a few days; and of cases in which the most important organs are the seat of a widespread disease, or in which the whole organism is, as it were, hit by a thunderbolt, and the patient succumbs even before the organs find time to develop the usual inflammatory changes.

I abstain altogether from the use of the term "puerperal fever." Its meaning has never been clear. Since first it became known, toward the end of the last century, that the disease was contagious, nobody liked to admit that he had a case of the kind on hand. The suspicion of having brought the disease himself might attach to the physician, and in good conscience he could not attend to other midwifery cases; so that on all sides he was a loser, and it was in his interest to have the domain of puerperal fever restricted as much as possible. The most serious inflammations were not admitted as proof of the presence of puerperal fever. Even a general peritonitis might simply be traumatic, as the saying was. Only the very worst cases were looked upon as puerperal fever; the milder figured under the name of an inflammation of the organ most prominently attacked, or under that of septicæmia as something different from puerperal fever. In my opinion the term "puerperal fever" can as little retain its place on the nosological table as "brain fever," "lung fever," or "dropsy"—so much the less so as sometimes there is no fever at all. Other names have been substituted, such as "metria" and "puerperal septicæmia." The first of these words is rather vague, but points toward the uterus as the starting-point of the disease; and, although this generally is so, still infection with all its consequences may start from any other part. Septicæmia, on the other hand, is too strong a term. I, at least, cannot use it for the group of cases I am called upon to discuss in this article. Septicæmia means that septic material circulates with the blood and has infected the whole system. This term applies aptly enough to the most serious cases, and becomes then synonymous with puerperal fever in the sense in which most practitioners and laymen take it, but is by far more comprehensive than the term as used by those who think there is a special essential fever—a disease *sui generis*, which only

attacks lying-in women, and differs from septicæmia as it appears in a wounded man or a non-pregnant woman. For the lighter cases, where the infection is arrested in or near the genitals, the word "septicæmia" could hardly be used with propriety.

In using the term "puerperal infection" I am well aware that it properly refers to the etiology, but I think we may quite as well use it to designate the effect of this cause, just as the word "cold" both signifies the morbid agent and the pathological condition produced by it. The word has the advantage that it points out where the disease comes from, and teaches us to take measures to prevent it. It covers the whole ground, severe and light cases, and this it ought to if Czerniowski¹ should be found to be correct when he states that the micrococcus which does the mischief is the same in the mild and the severe cases of infection—namely, *Streptococcus*.

The difference in the symptoms and in the danger may be accounted for in many ways. Continued investigation, better instruments of observation, improved methods of cultivation may show that there are different species of microbes at work in different cases.

Perhaps the mere number of micrococci that invade the system make the difference. According to Pasteur, the innocuous micrococci that live in the vagina become dangerous if they are developed in great number and occupy the deep parts. They consume the oxygen found in pus, and thus clear the way for another class of microbes which cause infection. He therefore says: "*Là où les germes abondent, là le danger existe*"—where there is an abundance of microbes there is danger.

Perhaps the difference is due to the different organs to which the microbes are carried accidentally. Entering one lymphatic vessel, they may be carried to a neighboring gland, where they are imprisoned and kept until their death, or evacuated through an abscess opening on the surface of the body. Entering another, they may be carried to the peritoneal cavity, cause general peritonitis, and continue their route through the stomata of the diaphragm to the pleura and the pericardium. Others, again, may lurk in the thrombus of a vein, a piece of which is detached and follows the current of the blood up through the vena cava, the right atrium and ventricle, and the pulmonary artery, until it is arrested in a fine branch of the latter and causes an abscess, from which, again, other organs may be infected.

Still another way to account for the difference in the virulence of the cases is the different power of resistance of the patient. Of three men exposed to the same draught, one may escape with a cold in his head, the other with a stiff neck, while the third contracts a pleurisy which kills him. This may, indeed, have some influence, but when we take into consideration that by far the greater number of victims to

¹ Czerniowski: in *Archiv für Gynäk.*, 1888, vol. xxxiii., No. 1, p. 101.

puerperal infection are young, healthy primiparæ, we will not lay an undue stress on the previous condition of the infected person.

Having united all cases supposed to be due to infection in one article, it is evident that the prognosis varies very much; but that will be pointed out in due time, and even with the light cases it is good to bear in mind that if not the likelihood, at least the possibility, of a bad turn and of the development of the most serious symptoms is connected with any case of puerperal infection.

The limits of the subject once decided upon, the next question that presented itself was how best to make use of the space destined for its discussion. Convinced that most of my readers will be intelligent men, already busily engaged in practice, but who have not had the advantage of training in a lying-in hospital, I have thought that I would best adapt myself to the special needs of the majority of them, and most further the welfare of their patients, by limiting the discussion of the nature of puerperal infection, its etiology, pathology, symptoms, diagnosis, and prognosis, to a brief indication of the most salient points, and to devote as much space as possible to a detailed description of the means by which infection is prevented and treated. The first part, I hope, will be circumstantial enough to give the reader a clear idea of what the disease in question is; in the second I strive to be his trustworthy guide in all the perplexities that beset an honest man who wishes to protect his patient from puerperal infection, or to cure her of it if she has already contracted it, and who has no hospital experience in this line to fall back on.

NATURE OF THE DISEASE.

Many have been the theories advanced about the nature of the more serious forms of puerperal infection, commonly called "puerperal fever."

Hippocrates, taking the effect for the cause, attributed it to the suppression of the lochia—a view that still found followers in the last century.

Puzos in France (1753) defended successfully the theory which had already been advanced by others before him, that "puerperal fever" was due to a metastasis of the milk. The fibrinous exudation found in puerperal peritonitis was taken for milk. If the patient developed phlegmasia alba dolens, the milk had settled in her leg. If delirium predominated, it was the milk that had mounted to her brain. If she contracted an arthritis, it was again the milk that settled in her joint. This theory, long time contemporary with the preceding one, survived its old rival. It has been believed by eminent physicians who are yet alive, and it is still the prevalent idea among the general public.

According to a theory at the time much credited by English writers,

puerperal fever had its origin in bilious and mucous substances accumulating in the bowels.

A decided progress toward a rational conception of the nature of the disease was made through the phlogistic theory, according to which it was due to inflammation. One class of authors attributed it to metritis, metrophlebitis, and metrolymphangitis; another took the inflammation of the intestines and the omentum to be the starting-point; a third, sharing the views of W. Hunter, looked upon the peritonitis as the focus from which it irradiated.

Some have identified puerperal fever with erysipelas—a view that even in modern medicine has found an expression in the denomination proposed by Virchow, “erysipelas malignum internum.”

Others looked upon it as a kind of typhus, especially hospital typhus. Others, again, took it for a form of intermittent fever.

Many great authors, among them Schuh and Trousseau, were of the opinion that the so-called puerperal fever was not one disease, but many different diseases—that puerperal women were more liable to diseases than others, but that these diseases were modified in a peculiar way by the puerperal state. These authors already denied that puerperal fever had anything characteristic, and said that exactly the same combination of pathological conditions was found in pregnant women, in virgins, in newborn children, and in men—a fact that nowadays is admitted by nearly all modern teachers.¹

In the opinion of the writer puerperal fever is nothing but the most serious cases of puerperal infection—a disease due to a poison coming from without, and probably produced by microbes; a disease which, with exceedingly few exceptions, takes its origin in wounds of the genital canal.

It is, however, only fair, and certainly in the interest of the reader, to give the other side a hearing; and I doubt if it could have a better representative than our honored Dr. Fordyce Barker. In concluding his discussion of puerperal fever he says:

“I shall now make my confession of faith in the following propositions:

“1. There is a fever which is peculiar to puerperal women, and is, therefore, appropriately called puerperal fever.

“2. The symptoms of this disease are essential, and are not the consequence of any local lesions; and it is as much a distinct disease as typhus fever, typhoid fever, or relapsing fever.

¹ Those interested in the details regarding these different views will find information in Eisenmann's *Wund- und Kindbettfieber*, Erlangen, 1837, and other works epitomized in F. Winekel's *Pathologie und Therapie des Wochenbetts*, 2d ed., Berlin, 1869, which has been translated here in America, by Chadwick of Boston, and in Dr. Fordyce Barker's *Clinical Lectures on Puerperal Diseases*.

"3. It belongs to the class of zymotic diseases, and results from some unknown blood-changes.

"4. We are as ignorant of the specific cause of these blood-changes as we are of those which develop relapsing fever, scarlet fever, or any other essential fevers.

"5. The determining cause of this fever may be either epidemic influences, contagion, infection, or, probably, nosocomial malaria.

"6. Any of the local inflammations may occur in the puerperal woman without puerperal fever; and, on the other hand, puerperal fever may be so severe as to destroy life without sufficient local disease to account for the symptoms or explain the cause of death.

"7. The specific causes which develop the exanthemata, such as scarlet fever and smallpox, may develop the specific disease with intense malignancy in the puerperal woman; but this does not transform the disease into a puerperal fever.

"8. Septicæmia may be developed in a puerperal woman, either from autogenetic or heterogenetic infection, without puerperal fever, but this infection may also complicate puerperal fever."¹

The common view now-a-days is that puerperal fever is identical with septicæmia and pyæmia occurring as a complication of wounds, and the idea begins to take shape that all inflammatory disturbances in childbed are caused by infection. The first opinion was already advanced by Eisenmann in 1837, and again by Sir James Y. Simpson in 1850.² Since then so many corroborative cases have been published that the identity between puerperal fever and septicæmia in the wounded may be looked upon as a proven fact.

As obstetricians it interests us particularly that identically the same disease which in puerperæ is called puerperal fever or septicæmia or puerperal infection is found in the newborn child. It may either be found in a child whose mother is similarly affected, or in the child of a healthy mother. The infection may take place through the placental partition, through the sores that so often are found in the mouth of the infant during the first days of its life, or through any accidental wound of the body; but the most common entrance is the physiological wound presented by the navel. It may also be produced by the aspiration into the lungs of putrid liquor amnii. The poison is most likely of parasitic nature. It may come from the mother, either through the placenta or the liquor amnii, but it may quite as well be brought by the doctor or the nurse, or cling to any object with which the child comes in contact; nay, perhaps it may even float in the air.

In 340 autopsies made by Runge in the lying-in department of the Charité Hospital of Berlin he found general sepsis in 36 cases. In 33

¹ Fordyce Barker: *The Puerperal Diseases*, 4th ed., 1878, p. 476.

² *Edinburgh Monthly Journal of Medical Sciences*, vol. xi. pp. 414-429.

of these the infection had taken place through external wounds, and of this number it was in 30 through the navel, as proved by the presence of umbilical arteritis. In 3 there were accidental wounds. Thus, only 3 were left in which the poison must be supposed to have entered by an uncommon road.¹

Credé, on the other hand, saw the infection take place from sores in the mouth in 9 children out of 10 who died of sepsis during a so-called epidemic of puerperal fever.²

That the less dangerous forms of puerperal inflammation are due to infection becomes probable by the modern investigations of bacteriologists, and finds a powerful corroboration in the clinical fact that since the introduction of the strict antiseptic preventive treatment, to be described later, these inflammations have become very rare, and have taken so benign an aspect that they can hardly be recognized as the same thing.

It is commonly believed that certain small organisms called microbes, germs, bacteria, or micrococci are the true cause of puerperal infection—a question which will be fully elucidated by another writer, who has made personal studies in this direction.

According to many authors, septicæmia is twofold—*heterogenetic*, when the poison is brought from without; *autogenetic*, when engendered in the body of the woman herself, but in the new light of bacteriology we cannot admit that the patient can produce any poison herself. All she does is to furnish the ground where the seed coming from without develops. Her lochial discharge, her bruised and torn tissues, the fluids stagnating in her genital canal, a blood-clot, a piece of placenta, or a shred of membranes in her uterus, are most favorable elements for the development of the microbes, but these must come from the outside in order to cause putrefaction and infection. If no germs entered the system of the woman, no woman would be taken sick, just as urine may be kept fresh indefinitely merely by keeping out the germs of the air.³

It has been proved that the vagina and cervix contain microbes which may cause disease when they get into the tissues. Consequently, a puerperal woman may be infected by microbes which were in her body before delivery; and in this sense we may admit autogenetic infection, but even then the microbes in question do not form part of the organism of the patient. They have got into her genitals from the outer world, and, while they did not do her any harm as long as she was protected by her vaginal and cervical epithelium, they may become

¹ Max Runge: *Die Krankheiten der Ersten Lebenstage*, Stuttgart, 1885, pp. 138–164.

² Credé: in *Archiv für Gynäk.*, 1884, vol. xxiii. p. 77.

³ W. Watson Cheyne: *Antiseptic Surgery*, London, 1882, p. 36.

dangerous when this is destroyed in many places, as it inevitably will be in childbirth.

Fritsch divides infection into pathogenic and non-pathogenic, the latter being substituted for "the auto-infection" of previous authors. Since the patient, according to his own description,¹ may be taken as sick by the non-pathogenic as by the other variety, and even die, I fail to see the practical advantage of the distinction.

Often puerperal fever appeared in so-called epidemics. According to Barker,² more than two hundred such epidemics have been described since 1740. These epidemics ravaged especially lying-in hospitals, but were likewise found in cities and country districts. Since the introduction of antiseptic midwifery these epidemics have entirely disappeared from lying-in hospitals and have become rare outside of them—a fact which is easily understood from the standpoint of the infection theory. Since we have learned to disinfect ourselves, our instruments, and our patient, and protect her against contact with substances that might carry infectious material, she is rarely taken sick, and by isolating her we prevent her from infecting others. The utter senselessness of the word "epidemic" as applied to puerperal fever is tersely expressed by Fritsch in the words that we might as well speak of an epidemic of gunshot-wounds after a battle.³

ETIOLOGY.

While the views on the nature of "puerperal fever" and allied diseases, which we unite under the name of "puerperal infection," are hypothetic, varying, and of more theoretic than practical interest, the etiology considers the real sources of these diseases, which have been found by experience. The practitioner will be glad, I am sure, to exchange the airy domain of theories for the solid ground of facts, proven to be so by irrefutable evidence.

It is a fact independent of all theories that puerperal women are more liable to disease than mankind in any other state.

Predisposing Causes.—The foundation of this vulnerability is already laid during pregnancy. The blood undergoes changes in quantity and composition. There is a general plethoric condition, an increase in the amount of fluid circulating in the blood-vessels. It is more watery. The red blood-corpuscles diminish, while the colorless increase in number. There is less hæmoglobin, albumin, fat, phosphorus, and iron than in the non-pregnant condition, and, on the other hand, a considerable increase of fibrin. This general plethora, this increase in leuco-

¹ H. Fritsch : *Grundzüge der Pathologie und Therapie des Wochenbetts*, Stuttgart, 1884, p. 42.

² *Loc. cit.*, p. 439.

³ *Loc. cit.*, p. 35.

cytes, and this surplus of fibrin can hardly fail to predispose to inflammatory diseases.

The heart, especially the left ventricle, is hypertrophied. The walls of the blood-vessels become thicker, and at the same time their bore becomes larger. It is especially in the breasts and in the uterus that these vessels become much developed. The muscular tissue of the uterus grows to keep pace with the development of the fœtus. The lymphatics become so dilated that they may be mistaken for veins. On account of the slower movement of the nourishing fluids in these dilated blood-vessels and lymphatics, there is a predisposition to the formation of thrombi, which again may lead to inflammation or become a dangerous means of general infection.

The great irritability of the nervous system developed during pregnancy, and which appears as headache, toothache, neuralgia, vertigo, unnatural longings for some things, morbid aversion to others, and similar phenomena, constitutes likewise a predisposing cause. Shame in those who give birth to an illegitimate child, dread of destitution for themselves and their offspring in the very poor, are all unfavorable complications of childbirth.

After any labor the patient is exhausted in consequence of pain or loss of blood; and much more so if the labor has been tedious and unusually painful. No child is born without causing tears and abrasions, which may become infected. Abnormal deliveries, in which it becomes necessary to use instruments or introduce the hand into the uterus, are particularly predisposing factors.

Immediately after the birth of the child the uterine sinuses are closed by the formation of thrombi—a physiological process that either may be defective or be carried too far, causing dangerous or deadly hemorrhage or thrombosis in the veins of the pelvis or lower extremities.

A large amount of tissue has to undergo fatty degeneration, be absorbed, and expelled. While, before the birth of the child, there was a strong current in the direction of the uterus, after its expulsion the current goes inward. The superfluous material must be liquefied and carried to the natural excretories. At the same time, the breasts enter upon a new and important function.

The lochial discharge contains debris from the parturient canal, and may become a propitious element for the development of micro-organisms, some of which are even found normally in the vagina and the cervix.

Primiparæ are even more exposed than those who have borne children before, because the labor takes longer time and the resistance of the soft parts is greater.

To crowd many puerperal women together augments the danger for

each of them. If one of them is attacked by puerperal infection, the danger of the poison being carried to others is the greater the nearer the patients lie to one another. Cleanliness becomes more difficult, and thus the mass of putrefying substances found in the ward increases, and with it the danger of infection of the patients.

The *special cause* of puerperal infection is a poison which seems to be produced by certain microbes. That the severe cases, those which by a general term may be called puerperal septicæmia, are due to sepsis, is proved by the fact that by antiseptic measures we succeed in preventing the disease, and that if it has made its appearance they have great power of conquering it. Another proof is that microbes have been found in such numbers and under such conditions that they must be regarded as intimately connected with the disease; but this point properly belongs to the domain of the bacteriologist.

We have seen above (p. 292) why the milder forms of inflammatory puerperal diseases are supposed to have a similar origin.

Sources of the Poison.—Independently of the question of the rôle played by micro-organisms, experience has more or less definitely made known the sources from which the poison comes, and which consequently have to be guarded against. Such sources are patients affected with the same disease, suppurating or decaying tissues, putrefying substances within or without the body, and perhaps zymotic diseases.

An enormous stride toward the protection of childbearing women was taken when it became known that puerperal infection is a contagious disease. The merit of the discovery belongs to British authors. In this country it was brought before the profession in a masterly way by Dr. Oliver Wendell Holmes of Boston, Mass.¹ Nowadays it is admitted by everybody that the disease may be brought from one person to another. The only difference is, that some authors (Schroeder) rather call it a transmissible disease, thinking that the puerperal septicæmia is not contagious in the sense in which we apply the word; *e. g.* to smallpox. A healthy person entering a room in which lies a patient affected with smallpox may contract the disease without touching the patient. Most German authors deny that any such transmission through the air takes place in puerperal infection, and think that the disease is exclusively produced by septic material being manually or in a similar direct way deposited in the genital canal, and entering the wounds found there. We will presently come back to this point.

Sometimes patients who have been infected by being examined in one

¹ In April, 1843, Dr. Holmes published a paper on the "Contagiousness of Puerperal Fever" in the *New England Quarterly Journal of Medicine and Surgery*, and reprinted it with an extensive introduction as a pamphlet in Boston, 1855, under the title *Puerperal Fever as a Private Pestilence*.

hospital have left it for another and caused other women to be infected from them in the new locality, probably through the instrumentality of vaginal examinations.

That the puerperal infection may arise from suppuration was already pointed out by Semmelweis in 1847.¹ A pregnant woman with cancer of the uterus was examined by the students, and became the cause of fourteen puerperal women being infected and losing their lives. In this country we have the celebrated case of Dr. Rutter of Philadelphia, who in the year 1843 had forty-five cases of puerperal septicaemia in his own practice, while none of his neighbor's patients were attacked. In vain he bathed, changed his clothes, shaved off his hair, wore a wig, and stayed ten days away from the city. He did not take anything with him to his next patient that he had ever worn or carried, and she had an easy parturition. Still, she died of childbed fever. At the time no explanation was found of such a fearful mortality following in the track of one obstetrician. Meigs taught his students to see a dispensation of God's providence in it.² Later the mystery has been solved by the statement made by the well-known reviewer R. P. H., on the authority of an obstetrician contemporary of Dr. Rutter, that he was subject to an obstinate muco-purulent coryza, from which septic matter found its way to his hands.³

A French physician had delivered eight hundred women without the least accident, when he was seized with a suppurating adenitis, for which he carried a drainage-tube. Within three weeks he had three cases of puerperal septicaemia.⁴

In the Maternity Hospital we recently had a paralytic patient who had a large carbuncle on the sacral region. Two other puerperæ lay in the same ward and were treated by the same nurse. One of them, who had been perfectly well during the first eight days of her puerperium, got a chill, followed by a rapid rise of temperature up to 105.6° Fahr. On the cervix was found beginning diphtheritic infiltration. This was cauterized, the uterus washed out with creolin, 2 per cent., a suppository with iodoform inserted, and the patient was given quinine and brandy. She recovered in a few days. She had, of course, been removed immediately from the ward when taken sick. So was the other woman, who remained well. The carbuncle case was removed to Charity Hospital, the nurses put to other work, and the ward disinfected. By these prompt measures further trouble was avoided. The carbuncle patient had no puerperal disease.

¹ Semmelweis: in *Wiener Zeitschrift*, Dec., 1847; *Schmidt's Jahrbücher*, 1848, vol. lviii. p. 196.

² Chas. D. Meigs: *Woman, her Diseases and Remedies*, 2d ed., Philadelphia, 1851, p. 608.

³ *Amer. Journ. Med. Sciences*, April, 1875, p. 474.

⁴ Sirédey: *Les Maladies puerpérales*, Paris, 1884, p. 99.

These are only a few instances among many showing that puerperal infection in its most serious aspect may be due to a poison formed in suppurating tissues.

Semmelweis also showed that the disease in the great lying-in hospital of Vienna was due to infection with poison brought on the hands of students going from the dissecting-room to the lying-in ward, and being allowed to examine the parturient women. The enormous mortality among the puerperal women dwindled down to a comparatively small figure when the students were compelled to anoint their hands before touching the dead bodies, and to disinfect them with chlorinated lime before examining the parturient women. From the foundation of the hospital in 1784 until the year 1823 the mortality was small: there had been twenty-five years in which it did not even reach 1 per cent., and a mortality of 4 per cent. had only occurred once during the whole period of forty years. This was before the study of pathology, that for a long period surrounded the Vienna school with unequalled lustre, had been inaugurated by Rokitansky. From that time until 1847 the mortality increased very much, and reached even 12 per cent.¹ In 1840 the hospital was divided into two services. In the first students were instructed; in the second, midwives. On alternate days the patients were sent to each of the two divisions, so that there was not the least difference in the nature of the cases on both sides. Nevertheless, the service in which the students were instructed had during the years 1841-46, 20,042 patients with 1989 deaths, a mortality of 9.92 per cent., whereas the second service, in which midwives were instructed, who did not dissect or make autopsies, had 17,791 deliveries with only 691 deaths, or 3.38 per cent.² Toward the middle of 1847, Semmelweis introduced chlorine as a disinfectant, and the result was a remarkable fall in the mortality, as shown by the following table, viz.:

Year.	Confinements.	Deaths.	Per cent.
1846	4010	459	11.4
1847	3490	176	5.0
1848	3556	45	1.27 ³

A similar case is reported from private practice. During a so-called epidemic of puerperal fever the Scotch physician Renton practised in the same locality as another doctor; all the patients delivered by the first remained healthy; all the sickness was on his neighbor's hand. As they were friends, the latter abstained himself from obstetrical practice and addressed all his cases to Renton. Not one was taken

¹ Semmelweis: *Die Aetiologie, der Begriff und die Prophylaxis des Kindbettfiebers*, Wien, 1861, pp. 61-63.

² Semmelweis: *loc. cit.*, p. 3.

³ Semmelweis: *loc. cit.*, pp. 56, 61.

sick. The only difference between the two was that Renton did not make autopsies, and his friend did.¹

The infection may as well come from tissue undergoing local death in the shape of gangrene.

Frequently pieces of placenta or membranes left behind in the uterus become the starting-point of puerperal infection. I saw once a curious case in which a rotten placenta did not infect its owner, but caused the most severe puerperal diphtheria in another woman. Two women were delivered at the same time, in the same room of the Maternity Hospital, by two different members of the house staff. The first was delivered of a macerated foetus, and a stinking placenta was manually removed. The uterus was washed out with bichloride of mercury, and she did well. The second had her vagina partitioned by a thick fibrous band that prevented the descent of the child and had to be severed. When the doctor who had attended the first woman was through, he was allowed by him who had the other to examine this latter. That was after we had introduced the strict antiseptic treatment, but most likely he did not take the special care necessary to clean his nails after having dug in such dangerous tissue as a putrid placenta. So much is sure: the second patient had a narrow escape from death. At the time this occurred there had not been a case of puerperal infection in the hospital for six months.

Some years before I was connected with the Maternity Hospital a new building was erected for the lying-in women. It had scarcely been opened before such a violent so-called epidemic of puerperal fever broke out that the building had to be evacuated, and has never been used since. One of the surgeons connected with the hospital at the time has told me that in his opinion this outbreak was due to guano with which the contiguous grounds had been covered in order to surround the new hospital with a garden.

Some years ago there was an epidemic of puerperal fever in the New York Infant Asylum, the cause of which was found to be a dead rat undergoing decomposition in the cellar.

On the same ground, the immediate neighborhood of a churchyard, a dunghill, a privy, a stable, a cesspool, a sewer, a pool of dirty stagnating water must be looked upon as dangerous for a lying-in woman. Fehling observed an epidemic of puerperal fever, diphtheria, and erysipelas which was caused by the bursting of a waste-pipe. The dirty water had found its way into the ground upon which the hospital was erected. As soon as the evil was remedied the epidemic stopped.²

The relation between puerperal infection and zymotic diseases is not quite settled. Since diphtheritic inflammation is one of the most common forms of puerperal infection, there can hardly be any doubt that

¹ Sirédey: *loc. cit.*, p. 98.

² Fehling: *Archiv für Gynäk.*, 1888, vol. xxxii. p. 433.

the poison may be brought from a person affected with diphtheria or diphtheritic wounds.

Typhoid fever is so well characterized by its peculiar intestinal ulcers, and is so different from puerperal infection, that they certainly are different diseases; but that does not prevent one from leading to the other.

Scarlet fever may attack a puerperal woman, but it remains scarlet fever, following the same course as in any other patient.

Erysipelas is likewise sometimes seen as a complication of the puerperal state. Since my occlusion dressing is used it has become exceedingly rare in the Maternity Hospital. Lusk¹ and Matthews Duncan² have proved by statistics that there is no constant relation between the appearance of the two diseases. Fehleisen succeeded in isolating and cultivating the bacillus of erysipelas, by which it was proved that it was a distinct disease, entirely different from any other. I recently saw it appear on the face of a pregnant woman, and the confinement take place during the attack, without the slightest complication. If erysipelas sometimes occurs in a woman suffering from puerperal infection, it certainly happens rarely, and not oftener than that disease attacks any other person who has open wounds. Gusserow injected Fehleisen's bacilli into the skin of two rabbits and produced erysipelas, but of six in which he injected the bacilli into the peritoneal cavity or in the subserous connective tissue not one was taken sick.³ All this goes far to show that erysipelas and puerperal infection are two different diseases, and that one does not lead to the other. Still, many think puerperal infection may be contracted from a patient affected with erysipelas. It is chiefly from English authors that the assertion has come that erysipelas may produce puerperal fever; but English physicians have often included diffuse cellulitis under the term erysipelas, and that a suppurating cellulitis can cause puerperal infection is a generally accepted doctrine.

Ways by which the Poison Enters.—In the overwhelming majority of cases the infection takes place through wounds of the genital tract. Most modern authors admit even only this entrance. In my opinion this is too exclusive. There is a highly interesting illustrative case on record which, being old, is easily overlooked.

Depaul, in the discussion on puerperal fever in the French Academy, reported the case of a pupil midwife who took care of a woman with severe puerperal fever. While she was washing the genitals she felt an unpleasant sensation. In the evening she was taken sick, and died on the third day "with all the symptoms of the most characteristic

¹ W. T. Lusk: "On the Nature, Origin, and Prevention of Puerperal Fever," extract from *Trans. International Med. Congress*, Philadelphia, 1876, p. 24.

² M. Duncan: "On the Alleged Occasional Epidemic Prevalence of Puerperal Pyæmia or Puerperal Fever and Erysipelas," in *Edinburgh Med. Journ.*, March, 1876.

³ Gusserow: in *Archiv für Gynäkol.*, 1885, vol. xxv. p. 179.

puerperal fever." The post-mortem confirmed the diagnosis, and she was furthermore found to be a virgin and not in a menstrual period.¹ Sceptics will of course say that she had a small wound on her hands which became infected, but if so the disease would in all likelihood have begun as lymphangitis of the arm, of which there is no trace in the report. It is therefore only fair to admit that the infection in this case took place through the mucous membrane of the lungs.

How the Poison is Carried to the Patient.—The common way in which the poison reaches the patient is through doctors, midwives, or nurses, who during examinations and manipulations deposit it in the genital canal. It may cling to a finger, an instrument, a lubricant, a sponge, a rag, or any other substance brought into contact with the genitals.

The examining finger may even carry the microbes found in the vagina and the cervix into the uterus, and cause infection. That is why an examination ought never to be undertaken before the vagina has been thoroughly disinfected; why we ought never to introduce the finger beyond the os externum if it can be avoided; and why a disinfectant intra-uterine douche should always follow when the uterus has been entered.

Many modern authors deny absolutely that the puerperal poison can be carried through the air. This is a view I cannot share. We have the historic proof that in many hospitals the mortality decreased considerably by the mere introduction of a better system of ventilation. Before we had our present antiseptic treatment in Maternity Hospital, and when the morbidity and mortality were at their worst, we always found that the patients placed in a ward that had just been fumigated with sulphur were free from fever for a week. The belief that the air can infect puerperæ has received its scientific basis in the observation that staphylococci and streptococci have been found floating in the air of the wards of hospitals. Sirédey² has reported a striking clinical case in point. A man suffering for six months from a stercoral abscess was nursed by his two nieces. Both were pregnant, both had very easy deliveries with an interval of two months, and still both were attacked by severe puerperal infection; and the child of the first had a few days after its birth a whitlow, a large abscess in the buttocks, and erysipelas all over the body.

While I therefore believe that the air can be the carrier of the puerperal poison, I wish not to be understood as if I meant that the whole atmosphere of a place could be contaminated. This is an old view exploded by the fact that in the same city one lying-in hospital or one

¹ Depaul: in *De la Fièvre puerpérale*, communications à l'Académie Impériale de Médecine, Paris, 1858, p. 31.

² *Loc. cit.*, p. 112.

district was the seat of a so-called epidemic, while another hospital or another district in the immediate neighborhood went scot-free. It is likewise disproved by the occurrence of many cases of puerperal infection in the practice of one physician, while another physician practising in the same locality had none—cases we have referred to above. It is only the air in buildings or in the neighborhood of a source of infection, such as a carrion, a sewer, a privy, etc., that can become the carrier of the poison.

Time of Infection.—The most common time for infection to take place is during the examinations and manipulations of delivery. But it may occur both before and after. Before delivery it may be brought on by examining the vagina without antiseptic precautions; nay, it may even arise in spite of the most scrupulous disinfection of the physician's finger if pathogenic microbes are carried from the vagina, where they are found normally, into the cavity of the uterus.

The late infections may be due to direct contagion, the nurse bringing the poison from one patient to the other; or germs carried by the air may enter the genital canal; or some of the microbes which were in the vagina before may multiply in the lochial discharge, and find their way into the interior of the tissues.

PATHOLOGY.

One of the characteristics of puerperal infection which has given rise to many misunderstandings is the great diversity of the pathological changes caused by the disease. This holds good even if we only think of those severe cases commonly called "puerperal fever," and applies, consequently, still more to our general term, puerperal infection. When, therefore, we now will try to point out these changes, it must be understood that they by no means are all present at once. By beginning with the external genitals and following the disease from organ to organ in a certain order, I hope to be able to give some idea of these manifold pathological conditions; and the reader will bear in mind that in different cases a smaller or greater number of organs are affected, and that the lesions may be of a milder or severer type.

VULVITIS AND VAGINITIS.—Catarrhal inflammation of the vulva and the vagina are characterized by redness, tenderness, and a mucopurulent discharge which becomes blended with the lochia.

The abrasions and tears which constantly are found in the external genitals frequently give rise to ulceration or become the seat of diphtheritic infiltration. This is in most cases of a light pearl-gray color, more exceptionally milk-white or sulphur-colored. It makes its first appearance as discrete spots not larger than a millet-seed, but soon these extend in all directions and melt together, so as to form one or more

large, thick patches, firmly adherent to, imbedded in, and, as it were, dovetailed with, the subjacent or surrounding tissue. The patches have commonly round contours, measure from one-eighth of an inch to one inch in diameter, and about one-eighth of an inch in thickness. Like diphtheria of the air-passages, this infiltration has a predilection for the places where the canal becomes narrower—namely, the entrance of the vagina¹ and the cervix. Probably this is due to the predominant frequency of vulnerations at these narrower straits. The posterior commissure of the vulva and the posterior wall of the vagina are much more liable to be attacked than the corresponding anterior parts, and on the posterior vaginal wall, again, that part which lies below the cervix is most frequently affected. The explanation of this is probably to be sought in the fact that these parts are more thoroughly bathed with the fluid coming from the uterus, which stagnates there, becomes mixed with germs suspended in the air or already located in the vagina, and undergoes decomposition.

All torn and abraded surfaces fall more easily a prey to this diphtheritic infiltration. But I have also seen it on apparently healthy parts of the mucous membrane, yet covered with epidermis and separated by intervening tissue from all tears and abrasions. Sometimes the inside of the labia majora is alone affected.

The parts surrounding the patches are more or less swollen, often the seat of considerable œdema, dark-red, brown, or dirty greenish.

An ulceration in the upper part of the vagina may give rise to an abscess pointing in the perineum (Winckel).² More or less destruction may be caused by gangrene.

ENDOMETRITIS.—The endometrium is normally not thrown off altogether when the ovum is expelled. The separation takes place between the superficial and the deeper layer, and regeneration takes place from the latter as a starting-point. The endometrium may be the seat of a catarrhal inflammation. Then it is red, swollen, and covered with a puriform fluid. Sometimes it is studded with small round prominences of the size of a pin's head which contain a purulent fluid. At the same time the lips of the os and the cervix are swollen and covered with granulations that easily bleed.

The other affections of the endometrium soon spread to the deeper

¹ It is a very common mistake to confound the entrance of the vulva, *rima pudendi*, with that of the vagina, *introitus vaginæ*. The vulva is as distinct from the vagina as is the uterus; as to development, even much more so. The vulvar orifice is situated on the surface of the body, forms a straight line running in an antero-posterior direction, and is bounded by the labia majora. The vaginal orifice, on the other hand, is situated at the bottom of the vulva, from one to two inches below the surface, is circular, surrounded by a striped muscle, the constrictor vaginæ, and is more or less completely bounded by the hymen or its remnants, the *carunculae myrtiformes*.

² *Loc. cit.*, p. 150.

parts of the wall, and we describe them, therefore, under the next heading.

METRITIS.—Four forms of metritis may be distinguished—the simple, the diphtheritic, the dissecting, and the putrescent. In them all the uterus is very much enlarged, sometimes reaching nearly up to the umbilicus a week or two after delivery. The cervix may be more or less torn, bruised, jagged, of a dirty-red, dark-brown, or greenish color. In bad cases large portions of it become gangrenous. The walls of the body are commonly very thick, ranging from one to two inches. The tissue is soft, friable, pulpy, near the inner surface almost diffuent, dark cherry-colored, and bathed in a thick, dirty-greenish fluid.

In the *diphtheritic* form small gray spots appear on the mucous membrane of the cervix, just as we have described the process in the vulva and the vagina. They may coalesce and form thick patches. In other cases only a fine gray film is found, like the bloom on a fruit. In the interior of the body similar formations may be found, especially at the entrance of the tubes. From here a yellow layer of diphtheritic infiltration may be followed out to the peritoneal covering of the womb.

Of *dissecting* metritis I have treated 8 cases, 6 of which I have described.¹ Besides, I have seen a specimen from the practice of another physician, and the Russian physician Süromiatnikow² has described 2.

The characteristic feature of this form is that a large piece of the muscular tissue of the uterus is entirely severed from its connection with the rest, and eventually expelled from the body. In the first case that came under my observation the patient died, and at the autopsy the loose body was found lying in the cavity of the womb. It was four inches long, two wide, and one thick. The walls were in some places as thin as tissue-paper, and even perforated by openings leading into the intestines. In the other cases similar bodies were expelled between the seventeenth and the forty-seventh day after delivery. The outside of these bodies has a grayish color; the cut surface is pink. Externally are seen round openings leading to canals filled with thrombi. Microscopical examination shows that these pieces consist of smooth muscle-fibres in a more or less advanced stage of degeneration. The amount of connective tissue between the bundles is considerably increased, and it contains numerous round cells. The thrombi are in the process of organization, being composed of a network of fibrin with

¹ Garrigues: "Dissecting Metritis," *New York Medical Journal*, 1882, vol. xxxvi. p. 587; *Archives of Medicine*, April, 1883.

² *Centralblatt für Gynäk.*, 1881, vol. v. p. 276.

interspersed round cells. Numerous veins and capillaries are seen filled with blood.

Since the introduction of strict antiseptis I have not had another case of the kind.

By the description of the macroscopical appearance and microscopical composition of these bodies it will be seen that they differ entirely from the condition described under the name of "putrescence of the uterus." This was also shown by the quality of the lochia, which sometimes were merely purulent, and not fetid at all. Nay, some of the patients did not even show any sign of being seriously ill.

Some cases of metritis offer the most horrid aspect. Of the many names under which this form has been described, that of "putrescence of the uterus" seems to be the most appropriate. The uterus is large, the walls thin, the external surface shows impressions of the intestines. The mucous membrane is changed to a brown or black, jagged, stinking slough, which hangs down in shreds or is movable on the subjacent tissue. The submucous connective tissue may be changed to a whitish mass, and the muscular tissue be dirty red, soft, and flabby. At other times the destruction goes deep into the latter, forming irregular cavities filled with a chocolate-colored or black pulp or a more ichorous or purulent fluid. The site of the placenta is particularly affected by this deep burrowing.

It may be that what I have described as dissecting metritis by less good treatment would have resulted in the putrescent form, but as it is it differs certainly in so pronounced a way from the description given of the putrescence of the uterus that it deserves a particular place in the description of the puerperal inflammation of the womb. According to my own observation, I think it is more likely that it is connected with the diphtheritic form, as in several of the cases of dissecting metritis there had been diphtheritic infiltration and patches, and as in one case an infiltration of this kind formed a layer extending from the inner surface nearly through the whole thickness of the wall, and circumscribing a large piece of comparatively healthy tissue, which if the patient had survived might easily have formed such a loose body as that found in the other cases.

SALPINGITIS.—The puerperal inflammation of the Fallopian tubes is always combined with endometritis, and is probably due to extension from the uterus. It is mostly a superficial-catarrhal-affection, characterized by the usual signs—redness, swelling, the partial loss of the epithelium—and the tube is filled with a purulent fluid. The mucous membrane may be the seat of diphtheritic infiltration, and the fluid become ichorous.

OÖPHORITIS.—The inflammation of the ovaries is a very common occurrence in the puerperal infection. There may be perioöphoritis—

that is, inflammation of the surface, with formation of pseudo-membranes. This is always combined with peritonitis. Parenchymatous oöphoritis is the inflammation of the inner substance. The ovary is swollen and saturated with a bloody fluid; often small hemorrhagic foci and streaks are found; the so-called albuginea¹ is apt to tear and let the stroma form round prominences on the surface: an abscess may form, or the whole interior become transformed to a thin sanious fluid.

CELLULITIS AND ADENITIS.—Any part of the subperitoneal connective tissue around the womb, at the base of the broad ligaments, between their folds, in the iliac fossa, the anterior and posterior abdominal wall, and the recto-ischiatic fossa may be inflamed. It becomes swollen, cedematous, infiltrated with a turbid serous fluid, and is often the seat of hemorrhagic thrombosis. This condition may end in resolution or in suppuration. If the abscess is found in the lower part of the abdominal wall, the pus may extend up to the umbilicus, make its way to the skin, and perforate it. An abscess of the iliac fossa points at the groin a little inside of the anterior superior spine of the ilium. An abscess formed in the anterior part of the small pelvis (by some authors called the obturator fossa) opens likewise at the groin, but inside of the femoral vessels, above the Fallopian ligament. A collection between the folds of the broad ligaments follows the ilio-psoas muscle downward, and may open below the Fallopian ligament. From the iliac fossa the abscess may extend upward and backward, and perforate the abdominal wall at the top of the crest of the ilium, where a small triangular space is left between the latissimus dorsi and external oblique muscles ("J. L. Petit's triangle" of French authors); or it may reach the lower surface of the diaphragm and form a fistula in the lumbar region. In rare cases the pus may follow the nerves out of the pelvis through the greater sacro-sciatic or the obturator foramen.

More frequently, than to wander in this way to some distant point and perforate the skin, the abscess opens into one of the hollow organs in its neighborhood—the vagina, the intestine, or the bladder.

The lymphatic glands in the pelvis are often swollen or suppurate.

LYMPHANGITIS.—The lymphatic vessels play a very important rôle in the propagation of puerperal infection. From the vulva and the lower fourth of the vagina the inflammation goes to the superficial inguinal glands, and may extend through the saphenous opening to the deep inguinal glands, or along the deep blood-vessels into the abdomen

¹ Under the epithelium of the ovary are found three layers of fibrous tissue: the most superficial and the deepest ones have longitudinal fibres, the middle one transverse fibres. This is what is called albuginea, but it is intimately connected with the deeper tissue, and cannot be separated from it with the knife (Waldeyer: *Eierstock und Ei*, Leipzig, 1870, p. 13).

to the lymphatic glands which are situated on the external iliac artery. In this way a neglected ulcer on the labium majus may give rise to a peritonitis.

From the upper three-fourths of the vagina and the cervix the lymphatics open into the internal iliac and sacral glands. Those of the uterus begin in the mucous membrane as spaces lined with endothelium. In the muscular layer are found similar spaces and vessels. They all communicate with a superficial layer of vessels in the serous covering. From the uterus the lymphatics go through the broad ligaments and reach the lumbar glands. In the normal condition the lymphatics are not visible unless made so by injection. In lymphangitis they become as thick as a goose-feather, and form prominences on the surface of the uterus which contain a puriform fluid and may be as large as a cherry.

It will be seen that the lymphatics form an easy road for puerperal infection from nearly the whole vagina and uterus to the peritoneum.

PERITONITIS.—This is the most common feature of the graver cases of puerperal infection. It may be local or general. In the first case it is limited to the pelvic organs, and even when generalized the affection is most pronounced here. As a rule, it starts from the uterus. The local form may be adhesive or purulent. The peritoneum is injected, partially covered with false membranes; the intestines are bound together, and often to the uterus, by a fibrinous exudation. A free serous or purulent fluid is found in the peritoneal cavity: often it has a milky color, which gave rise to the theory of the disease being a metastasis of the milk. Large solid masses, much like curdled milk, are found in it. The intestines are distended with gas, and lift the anterior abdominal wall up, so as to form a uniform convex swelling.

PLEURISY AND PERICARDITIS.—From the peritoneum the inflammation sometimes extends to the pleura and the pericardium, an easy passage being offered the microbes through the stomata of the diaphragm, openings leading from the peritoneal cavity into the lymphatics. The pathological changes are the usual ones—swelling, imbibition, injection, formation of false membranes, and more or less sero-purulent fluid.

PHLEBITIS.—The inflammation of the veins is not so common as lymphangitis, and is often combined with the latter and peritonitis. Phlebitis is intimately connected with thrombosis. In most cases the latter precedes, but sometimes it may be secondary, the inflammation working its way in from the sheath of the vein and causing roughening of the endothelium, leading to the precipitation of the fibrin of the blood. We distinguish uterine phlebitis and phlebitis of the lower extremity.

1. *Uterine Phlebitis.*—The uterine sinuses are normally closed by thrombi near the inner surface, but abnormally the thrombosis may extend not only through the whole thickness of the uterine wall, but

follow the uterine and the internal iliac veins or the ovarian veins to the vena cava inferior. The formation of a thrombus may also be due to compression interfering with the free reflux of the venous blood, or to the slow movement of the blood in consequence of the dilatation of the vessels mentioned above.

A thrombus may again become canalized, or it may be organized to a solid plug of connective tissue, permanently closing the vein. Abscesses may form in the uterine wall in contact with the inflamed vessel. A piece of the thrombus may be torn off and carried away by the current of the blood, causing the usual phenomena of embolism. The thrombus may melt in the centre, forming pus or a sanious fluid. This may break through into the blood-current, causing similar processes to take place in nearly all the organs of the body.

Most frequently the *lungs* are affected. Wedge-shaped infarctions are formed with the base turned to the pleura and the apex in the direction of the root of the lung. Here the tissue is hardened, friable, dark brown, and gives rise to lobular pneumonia. Soon grayish spots appear in it, which coalesce and form an abscess. Besides, there may be found hypostatic pneumonia in the posterior part of the lungs. The mucous membrane of the bronchi is commonly swollen and injected.

The *spleen* is much enlarged, soft, and the seat of similar infarctions as the lungs, but they rarely form abscesses.

The *kidneys* are hyperæmic, and often the seat of infarctions and metastatic abscesses. After protracted suppurations they may become a prey to amyloid degeneration. Sometimes the abundant cellular tissue in which the kidney is imbedded is the seat of inflammation.

The *liver* is large, soft, friable, its cells enlarged, cloudy, and full of fat-globules. Metastatic abscesses are formed.

The mucous membrane of the *intestine* is usually œdematous, the follicles and the lymphatic glands swollen. No ulcers are found.

The *heart* may be affected by endocarditis, which mostly becomes ulcerous. The principal seat is the mitral valve, especially its lower surface. The leaflets of the valve become thickened, and sometimes vegetations are found on their borders. Miliary abscesses are formed in the deeper layer of the endocardium. The muscular part of the heart may harbor large abscesses (myocarditis). The pericardium may be thickened, injected, covered with false membranes, and its cavity contain sero-fibrinous or purulent fluid (pericarditis).

OPHTHALMIA.—Both eyes may be destroyed. The process begins as conjunctivitis, but soon pus forms between the choroidæa and the retina, and ruptures through the vitreous body and the cornea.

Meningitis, phlebitis, and thrombosis of the veins of the *brain* are rare occurrences.

Inflammation and metastatic abscesses are likewise found in the *breast*, the *parotids*, the *tonsils*, and the *thyroid body*.

On the *skin* appear erythematous, erysipelatous eruptions, and milary vesicles or large pustules filled with pus.

ARTHRITIS.—The joints, especially those of the shoulder, elbow, wrist, knee, hip, pelvis, and between the sternum and collar-bone, are often inflamed. Articulations may be swollen, their synovial membrane injected; a purulent fluid may fill their interior and break through to the surface. Ligaments, cartilages, and bones may be implicated, and a permanent ankylosis may be the final result.

In the *subcutaneous and intermuscular tissue* may be found large abscesses and masses of mortified tissue.

2. *Phlebitis of the Lower Extremity*.—The disease called phlegmasia alba dolens is in most cases combined with phlebitis. Sometimes a thrombosis of a vein is the original lesion, to which may be added periphlebitis and diffuse cellulitis of the lower extremity. In other cases the inflammation of the connective tissue is the first lesion, with which later may or may not be combined thrombosis and phlebitis.

In the first class the thrombosis of the veins of the leg may be a primary lesion, and already begin during pregnancy, or it may be secondary, a sequel to a similar condition in the internal and external iliac or the ovarian veins. The thrombus may be resolved or organized to a solid plug of connective tissue, or it may give rise to periphlebitis and diffuse cellulitis of the extremity, or it may soften, suppurate, and produce all the same metastatic processes just described for the uterine variety.

The second form of phlegmasia alba dolens is a cellulitis starting from the abdominal wall, the genitals, the perineum, and the buttocks, and spreading over the lower extremity on one or both sides. The leg swells. The skin is pale or slightly pink, tense, and thickened. Large vesicles filled with serum may appear on it. Both the subcutaneous and the intermuscular connective tissues are affected. Thrombi may form in lymphatics and veins. But in other cases the inflammation does not go beyond the sheath of the vessels, and their interior remains intact. The inguinal glands swell. The connective tissue may suppurate and the abscesses perforate the skin, or mortification may set in. This pernicious form is fortunately very rare. Varicose veins predispose to the formation of thrombi.

ACUTEST SEPTICÆMIA.—In this form of puerperal infection we do not find very great pathological changes. The process is so rapid that the different inflammations heretofore described hardly find time to be developed before the patient succumbs. Still, there are traces of lymphangitis or phlebitis of the uterus, swelling of the connective tissue, a little bloody serous fluid in different cavities; the glandular organs

of the abdomen are enlarged, soft, friable, their cells in the condition called cloudly swelling; the blood is dark, thin, and little prone to coagulation.

SYMPTOMS, DIAGNOSIS, AND PROGNOSIS.

VULVITIS AND VAGINITIS.

SYMPTOMS.—The catarrhal inflammation causes smarting, especially after micturition. In the ulcerative form there are often swelling of the labia and a moderate rise in temperature. The lochial discharge is liable to become fetid. Sometimes the patient cannot pass her urine. The ulcers heal slowly; two or three weeks may be required.

The diphtheritic form is much more serious. The first symptom which shows a deviation from the normal course of the lying-in period is the fever, which mostly occurs in from two to four days after delivery, more exceptionally on the same day or as late as six or seven days after. Sometimes it is ushered in by a decided chill or by a chilly sensation. The temperature may at once rise to 103° or 104° Fahr., but commonly it is lower and rises gradually. The highest temperatures in my hospital cases ranged from 100.6° to 107° , and in the majority it was between 102° and 104° . The temperature has no typical curve, except that, as a rule, it is higher in the evening than in the morning.

The pulse is accelerated. The highest frequency in our cases ranged from 88 to 160 beats per minute; in the majority it was between 112 and 120. It has a great tendency to become weak.

The respiration, likewise, is accelerated. The highest rate per minute ranged from 28 to 58; in the large majority it varied between 28 and 32.

The patient has no appetite. The tongue is coated. Often there are vomiting and diarrhœa. Generally she complains of pain in the hypogastric region or in one or both groins, sometimes extending down to the legs.

As a rule, the uterus is implicated, and we find it large and tender. This tenderness may spread more or less over the abdomen, and very often it is found in the groins, where likewise some swelling may be observable. The abdomen may become tympanitic. Sometimes peritonitis develops.

The lochial discharge is mostly scant, dirty-grayish, and offensive, but if the process does not extend to the uterus it may be normal.

The secretion of milk in the more severe cases does not begin, or stops soon.

The nervous system may be considerably disturbed, as proved by the presence of severe headache, stupidity, or delirium.

Very commonly there are abnormalities in the secretion or evacuation of the urine. Sometimes the urine contains albumen, bladder epithelium, and young round cells. The amount is often diminished. Uræmic symptoms may develop. Micturition is often frequent and painful. There may be enuresis or retention.

The labia are often œdematous; erythema or erysipelas may start from the genitals and spread over large parts of the body.

In rare cases there are jaundice, sweet breath, and profuse perspiration.

The signs of a general disturbance of the system often precede the appearance of the diphtheritic infiltration for several days.

The patches appear from two to ten days after confinement, commonly from three to seven days. (For the description of these patches the reader is referred to the section on Pathology.) The disease, as a rule, spreads for several days, either by the extension of already affected places or by the appearance of new centres at a distance from the first ones. From the time infiltration ceases until the sloughs produced by the treatment are cast off and the sores healed, about a week elapses. When once the diphtheritic process has stopped the patient recovers rapidly.

More or less extensive destruction may take place if the tissues become gangrenous. This occurs especially in difficult instrumental deliveries if proper antiseptic precautions are neglected.

Where there has been considerable loss of substance the vagina may be more or less constricted by cicatrices. Once I had the opportunity of seeing a patient of this kind during a following pregnancy. The extensive cicatricial tissue softened, and did not cause any obstruction to the birth of the child.

As to DIAGNOSIS, I shall only mention that torn or abraded surfaces may be simply covered with a thin yellow layer of inspissated pus, which might be taken for diphtheritic infiltration, but which differs from it by being strictly limited to the surface of the wound, from which it can be wiped off, while diphtheritic infiltration begins in discrete spots, forms a thick membrane, penetrates the subjacent tissue, and may appear in apparently intact parts of the mucous membrane. Besides, these pus-covered surfaces do not give rise to fever or any other symptom, and heal without any treatment except the occlusion bandage to be described later.

The PROGNOSIS is good in the catarrhal and simple ulcerative form. In the diphtheritic it ought to be very guarded. Out of 27 of my patients, whose histories formed the base of a paper on puerperal diphtheria,¹ 5 died.

¹ Garrigues: "Puerperal Diphtheria," in *Trans. Am. Gyn. Soc.*, 1885, vol. x. pp. 96-116.

ENDOMETRITIS AND METRITIS.

SYMPTOMS.—In the *simple* inflammation of the endometrium and the muscular tissue there are moderate fever, sometimes ushered in by a chilly sensation, some pain, especially severe after-pains, headache, anorexia, and a coated tongue. The lochia are fetid, and stay red longer than normal or become red again after having been yellow. There are subinvolution and some tenderness of the womb.

The *diphtheritic* inflammation has been described, together with that of the vulva and the vagina.

The *dissecting* metritis is only a pathological curiosity, and does not give rise to special symptoms, except a protracted purulent discharge.

The *putrescent* form is likewise mostly of anatomical interest. Still, it is characterized by symptoms similar to those of the worst diphtheritic cases, and by a particularly stinking, dark lochial discharge.

PROGNOSIS.—The prognosis of the simple endometritis and metritis is favorable. It lasts a week or two. In the diphtheritic form it is doubtful, as it often leads to the patient's death. The dissecting form seems to have a comparatively good prognosis. Of 11 cases known to me, only 1 ended fatally, and in this one death was accidental. The putrescent, on the contrary, is nearly absolutely fatal.

SALPINGITIS AND OÖPHORITIS.

The symptoms of these affections become blended with those of endometritis and peritonitis, which they accompany.

CELLULITIS (PARAMETRITIS) AND ADENITIS.

SYMPTOMS.—The inflammation of the cellular tissue is most frequently announced by a chill or chilly sensation, followed by a continuous fever, with the usual general symptoms of headache, anorexia, and weakness. The pulse and the respiration become more frequent. The patient complains of pain on one side of the uterus. By bimanual examination we find a swelling in one of the broad ligaments. The uterus is hardly movable. When the swelling increases in size it pushes the uterus over on the opposite side. In rarer cases both sides are affected. By pressing on the nerves passing through the pelvis the exudation may give rise to violent neuralgia in the lumbar region and the thigh. If the inflammation extends to the iliac fossa or begins there, the leg is drawn up and adducted, so that the knee rests on the thigh of the healthy side. The whole leg becomes more or less cedematous. Sometimes thrombi may be felt in the veins in Scarpa's triangle or at the popliteal space. The inguinal glands may swell.

In most cases the swelling of the connective tissue ends in resolution and the patient regains her health. In others suppuration sets in. This

is marked by a repetition of the initial chill and a rise in the temperature. The swelling softens and gives the sensation of fluctuation. The pus may be evacuated through the intestine, the vagina, the bladder, the uterus, or extend, in the manner described above, along certain muscles and ligaments and perforate the skin in certain places. These migrations are often very slow, and the woman's strength is sorely tried. Often the process goes on even after perforation has taken place. Long fistulous tracks are formed, the fever continues, and the skin is again perforated in other points. If the pus is evacuated through one of the hollow organs, it is mixed with the urine, the stools, or the lochia. As a rule, the abscess is then soon closed. Exceptionally, fecal matter passes from the intestine into the abscess, and keeps up the inflammation indefinitely until a counter-opening is made and free drainage established.

DIAGNOSIS.—It is sometimes quite difficult to decide whether a pelvic exudation is intra- or extra-peritoneal. Cellulitis begins nearly always on one side, and is mostly limited to that. The intra-peritoneal effusion is not bound to any particular line of demarkation, and is found most frequently in Douglas' pouch. Later, the extra-peritoneal effusion goes farther away from the peritoneum, especially down the side of the vagina or to the upper part of the thigh, whereas a peritonitic exudation, if it spreads, extends over on the other side or upward. Cellulitis is nearly always connected with a tear in the vaginal portion.

PROGNOSIS.—As a rule, the prognosis is good. The swelling may disappear in a few days, but it may also last for many months without suppurating. If suppuration sets in, the danger is greater, but with proper treatment even then nearly all recover within a few weeks. The most favorable place where the abscess can open is in the vagina, and that is at the same time the most common. A rupture into the peritoneal cavity is exceedingly rare, and fatal if laparotomy is not performed at once. If cellulitis is found as part of a general infection of the whole system, the result as to life and time is very uncertain.

LYMPHANGITIS.

Lymphangitis may take its origin from the vulva or from the uterus.

1. *Vulvar Lymphangitis*.—Lymphangitis may start a day or two after confinement from a sore in the vulva and lower fourth of the vagina, and follow the lymphatics to the superficial inguinal glands. The common symptoms of fever, such as accelerated pulse, increased temperature, loss of appetite, general malaise, are present. The vulva smarts; the labia may swell; red streaks appear on the skin leading to the groin, where the superficial glands swell, but very rarely suppurate.

PROGNOSIS.—If the lymphangitis does not extend any farther, it is of small importance and lasts only a few days. But if the inflammation implicates the deeper inguinal glands and the one in the crural ring, it may enter the abdominal cavity and cause peritonitis.

2. *Uterine Lymphangitis*.—Lymphangitis of the uterus gives rise to pain in the lower part of the abdomen. The uterus is large and tender, especially at the horns. The usual fever symptoms are present. The pulse is accelerated and full. There may be a little vomiting and some tympanites.

DIAGNOSIS.—Uterine lymphangitis differs from local peritonitis by the absence of swelling in the vaginal vault—from general peritonitis by the absence of green vomit, the limitation of the swelling to that part of the abdomen situated below the umbilicus, and the volume of the pulse.

PROGNOSIS.—If the lymphangitis continues to be limited to the uterus, it is not dangerous, but it may spread and cause inflammation of the cellular tissue or of the peritoneum. Sometimes it gives rise to subinvolution of the uterus and the symptoms characteristic of chronic metritis.

PERITONITIS.

Local peritonitis must be distinguished from general peritonitis, both on account of the difference in degree of the symptoms and in the prognosis.

1. *Local Peritonitis*, like most other puerperal inflammations, is commonly ushered in by a chill, but this lasts from ten to twenty minutes or more, and is accompanied or followed by a peculiarly intense pain in the lower half of the abdomen. There is great tenderness even on slight pressure. The temperature rises suddenly to 103° or 104° Fahr. The pulse beats 100 to 120 in the minute, and is small and hard. The respiration is also accelerated. The fever is continuous, but shows an exacerbation toward evening. During the chill the face is pale, but with the reaction the cheeks become colored and the skin moist. Often perspiration is present. The patient has no appetite, but an unquenchable thirst. The tongue is coated. In the beginning there is constipation, later followed by diarrhœa. Sometimes there is vomiting of food, mucus, and bile. Moderate hicough may trouble the patient. The lower half of the abdomen is distended.

The woman lies on her back, and draws up her knees in order to lessen the tension in the lower part of the abdomen.

The secretion of milk is sometimes normal, at other times diminished.

The lochia are scant, and often offensive and dirty. In the course

of a week or two a distinct tumor is felt above the pubes and in the vagina. It comprises the uterus, the appendages, and part of the intestines, bound together by inflammatory exudation and false membranes. It is somewhat uneven; the different parts offer a different degree of resistance and a different tone on percussion. Sometimes a kind of crepitation, like that in a snowball, may be felt on pressure. It takes place probably in adhesions. In the vagina the tumor is most frequently felt in Douglas' pouch, pushing the uterus forward. It may also be found on one side, and tilt the fundus over to the other. Where it is found it presses the tissues below it downward. Thus the cervical portion is effaced, the cervix appears thicker, and no distinction can be made out between it and the body of the uterus. The uterus is kept immobile by the inflammatory products.

This swelling may end in resolution in the course of two or three weeks. Gradually the pain, tenderness, fever, swelling, etc. diminish and the patient is restored to health. It may also suppurate. Then there is an exacerbation of the fever, with one or more chills; the swelling softens, and distinct fluctuation or boggy mass may be felt in some place. The pus may find an exit through the vagina, the bladder, or the intestine. If it tends to open into the vagina, distinct fluctuation can be felt here. The approach toward the bladder is marked by frequent micturition and dysuria. The advance toward the rectum is heralded by tenesmus. Wherever the abscess ruptures a considerable flow of offensive pus, mixed with grumous masses, is evacuated. If the opening is large enough and in a favorable locality, the abscess may be emptied at once, and soon close. But if the opening is too small for complete drainage, or situated above the bottom, or if the tumor is composed of different compartments, the process of evacuation may be very protracted. At times there are a cessation of the flow, an exacerbation of the fever, and an increase in the swelling until a new opening is formed. This may end the scene, or the process may go on indefinitely until the patient dies of exhaustion.

The pus may likewise follow the wall of the vagina and form a large abscess in the ischio-rectal fossa. The bladder and the intestine may also become inflamed. From the bladder the inflammation may work its way up through the ureters to the kidneys and produce pyelo-nephritis. Even pulmonary phthisis may be added to the other manifestations of disease.

PROGNOSIS.—The local peritonitis, as a rule, ends in recovery, but in some cases it may become a general peritonitis, which commonly soon ends the patient's life. Or it may take the protracted course just described, when the patient is exposed to death from exhaustion. Even the mild form, that ends in resolution, is in so far a serious disease as it is very apt to leave the patient in a condition of incomplete

recovery. When once there has been peritonitis it is very liable to return. It may cause abnormalities of the internal generative organs which make the patient an invalid for life, it may interfere with ovulation and impregnation, and it may become a source of suffering in a new pregnancy.

2. *General Peritonitis* offers the same symptoms as local peritonitis, much intensified. It begins, as a rule, from two to four days after delivery, but may follow immediately after parturition. The rigor is very long, lasting from half an hour to several hours. The pain is exceedingly severe, and spreads rapidly all over the abdomen. The pulse is very frequent, 120 to 160 in the minute. The respiration is very much accelerated, 26 to 56 per minute, and shallow, both on account of the pain produced by the respiratory movements and on account of the compression of the lung caused by the tympanitis. The patient lies on her back with the knees drawn up, avoids every movement, and dreads every approach. Even the weight of the bed-clothes may be intolerable. Her face expresses the greatest anxiety and pain. Her features are pinched; the angles of the mouth are drawn down; the eyes sink deep into the sockets, and have a dark streak under the lower lid. The skin is pale. The tongue is dry, red at the point and the edges, brown in the middle. The thirst is unquenchable. The woman vomits continuously, and the vomit soon gets a characteristic green color, which has been compared to hacked spinage. Commonly she has diarrhœa, and frequently hiccough.

The urine is scant or suppressed, must usually be drawn with a catheter, and contains often albumen.

The milk secretion soon ceases. The lochial discharge is scant, often fetid, or it stops altogether.

The abdomen is enormously distended by gas in the intestines. These at the same time push the diaphragm up to the fourth rib. The percussion sound at the top is tympanitic, at the sides dull or flat. The mind may stay clear to the last, but sometimes somnolence or delirium prevails. Insomnia is common.

PROGNOSIS.—General peritonitis is one of the most dangerous of puerperal diseases. Still, the patient may survive.

Favorable signs are the decrease in the frequency of the pulse and the respiration, the fall of the temperature, the disappearance of the abdominal pain, the subsidence of the distension, the cessation of the vomiting, return of cheerfulness, appetite, and strength.

Bad signs are a pulse above 140, a temperature above 104° , a laborious respiration over 40, severe diarrhœa, cold, clammy extremities, the appearance of large purple spots, profuse perspiration, a feeble, irregular pulse, the subsidence of the pain, while the distension of the abdomen increases.

Death occurs commonly at the end of nine or ten days, except in the acute cases caused by rupture of an abscess into the peritoneal cavity, when life is ended in a day or two.

If local peritonitis gives rise to invalidism and permanent pathological sequelæ, this applies, of course, still more to general peritonitis.

PLEURISY.

Most frequently pleurisy is added to a pre-existing peritonitis, but it may be found without the latter. Sometimes it is due to phlebitis and embolism.

If combined with other inflammations, it is not easy to diagnosticate. If added to peritonitis, the respiration becomes still more embarrassed and there is an exacerbation of the fever, perhaps a new chill. On account of the pain caused in disturbing the patient it is hardly feasible to make a thorough physical examination. If it is possible to do so, it elicits the usual signs of an exudation in the pleural cavity. The exudation is sero-purulent, similar to that in the peritoneal cavity. If due to infected emboli, it is always purulent. This form may appear quite insidiously, and is, as a rule, combined with similar affections of other organs.

PROGNOSIS.—Pleurisy is always a very serious complication of child-bed.

PNEUMONIA.

Pneumonia is found in two forms—either as a hypostatic affection of the most dependent parts of the lungs or as multiple foci around infected emboli and infarctions. It is commonly combined with pleurisy. The inflammation of the lungs is characterized by pain in the chest, cough, fever, bloody expectoration, and dyspnoea; but these symptoms may be absent or masked by concomitant disorders. The condition can then only be diagnosticated by the stethoscopic signs characteristic of pneumonia outside of the puerperal state—crepitant râles, bronchial respiration, and a flat percussion sound.

The PROGNOSIS is grave.

PERICARDITIS.

Like pleurisy, the inflammation of the pericardium may either simply be propagated through the lymphatics from the peritoneal cavity, or it may be due to an invasion of emboli from a venous thrombus.

The SYMPTOMS become mostly merged in those due to the other affections present. Sometimes a friction sound may be heard or an increase in the dull area belonging to the heart.

PHLEGMASIA ALBA DOLENS.

1. *Thrombo-Phlebitic Form.*—A thrombus may form in the femoral vein during pregnancy. It is accompanied by some fever and a heavy feeling in the extremity. It is rare to see it appear during the first days after confinement. Generally, it comes on in the second week of the lying-in period. Sometimes it is preceded by gastric disturbances, anorexia, bad taste, a coated tongue, eructations, and constipation. There may be a chill, and at all events the patient is feverish in the beginning. The urine is high colored. If the thrombosis begins primarily in the leg, this swells from the foot upward to the groin, or the swelling may extend over the adjoining part of the abdomen; if it is consecutive to thrombosis of the pelvic veins, the swelling follows the opposite course. The leg is painful; the skin is whitish and tense; by means of palpation the affected vein can be felt as a hard, sensitive string; the epidermis may be raised in large vesicles, which burst; the skin may redden in some places, and be perforated by an abscess. The affection may pass over on the other extremity through obstruction of the vena cava inferior, or it may begin there independently.

The phlegmasia commonly ends in resolution in the course of three to six weeks. Suppuration may set in and the patient still recover. Death may be caused by gangrene or septicæmia.

2. *Cellulitic Form.*—In the cellulitic form of the disease there are high fever, considerable pain, redness of the skin, bullæ, extensive suppuration of the subcutaneous and intermuscular connective tissue, and considerable mortification. Large shreds of necrosed connective tissue may be expelled and the sores heal, but there is great danger of the patient succumbing to septicæmia or of her being exhausted by suppuration and gangrene.

VARICOSE PHLEBITIS.

Varicose veins are more disposed to the formation of thrombi and phlebitis than healthy veins. In the majority of cases the symptoms are of small importance—some pain, tenderness, and moderate œdema. If the deeper veins are affected, the skin acquires a peculiar purple color, which has given rise to the name *phlegmasia cerulea dolens* as opposed to the white variety. In some places hard nodules are felt. The vein becomes fastened to the neighboring tissues. As a rule, this condition ends in resolution, but a periphlebitic abscess may form and open on the skin. Finally, the thrombus in this form, as well as in the preceding one, may become infected, soften, break down, and give rise to all the phenomena accompanying uterine phlebitis.

The prognosis of varicose phlebitis is, therefore, upon the whole, good, but still it ought to be a little guarded.

UTERINE PHLEBITIS.

There may be a simple thrombosis of the uterine sinuses, which may extend to the other pelvic veins, but it can hardly be recognized until it reaches the iliac veins, when we get the swelling of the lower extremity which has been considered under the title "*Phlegmasia alba dolens*."

On the other hand, the uterine thrombus may become the seat of an infection of the worst kind, and give rise to infectious uterine phlebitis, one of the most serious puerperal diseases.

It begins with an intense and long chill, followed by other chills without any regularity. It is furthermore characterized by metastatic processes in one or more organs. The chills are probably caused by the invasion of the septic matter (micrococci or their chemical products) into the blood. In the beginning the fever is somewhat like an intermittent fever, but the more widely the metastases are distributed the more it assumes a continuous type. During the chills the temperature rises to 104° or 106° , the pulse beats 140 or 160, the respiration becomes as frequent as 36 or 56. In rare cases there are no distinct chills, but only a chilly sensation. In the intervals between the chills, especially during the first, the patient feels great relief; the temperature sinks to 100° or 101° ; the pulse and the respiration become much less frequent. The patient has no pain; often there is even no tenderness. There is no tympanites.

But soon the aspect changes. The skin takes a yellowish tint, and sometimes there is pronounced jaundice. The nose looks pinched; the cheeks are hollow; the tongue is dry and coated. There is complete anorexia, but great thirst, insomnia, headache, sometimes diarrhoea, less frequently vomiting. The urine is scanty, and contains almost always albumen.

The organs first affected by the secondary infection are the lungs, then the pleura, the heart, the liver, the kidneys, the spleen, the intestines, the meninges, the brain, the eyes, the articulations, the skin, and the connective tissue.

We have spoken of pneumonia, pleurisy, and pericarditis above, and will soon make a few remarks on the other localizations.

DIAGNOSIS.—The repeated chills, with comparatively free intervals, give puerperal phlebitis some resemblance to malarial fever. But the chills in puerperal phlebitis do not come with the regular type of malarial fever, and the longer it lasts the more continuous becomes the fever. Sometimes the swollen veins may be felt in the pelvis. If a *phlegmasia alba dolens* is added, the nature of the disease is clear. Uterine phlebitis is often accompanied by repeated uterine hemorrhages. The appearance of the metastatic affections is entirely characteristic of phlebitis.

Puerperal phlebitis developing adynamic or ataxic symptoms may in some degree simulate typhoid fever. The first point to settle is that the patient has recently been confined. If this is concealed, it can easily be ascertained by the condition of the genitals, the abdominal wall, and the breasts. (See Vol. I. p. 526.) A puerpera may, of course, have typhoid fever, but this happens very rarely. In typhoid fever there is pain on pressure in the right iliac fossa; the stools have a peculiar yellow color; a few pink spots appear on the abdomen; the temperature is continuously high; visceral complications are rare; a decided change for better or worse takes place at the end of the third week. In puerperal phlebitis there may be gargouillement, but no pain on pressure in the right iliac fossa; the skin may show an eruption, but it is more extended and has the character of erysipelas, uniform erythema, large purplish patches, papules, or petechiæ. The temperature rises suddenly to a great height, and falls again several degrees, to rise again at irregular intervals. Every rise is, as a rule, accompanied by a severe chill. Complications in different organs are a chief feature. The disease has not even approximately a regular course.

The distinction between puerperal lymphangitis and phlebitis is of more scientific than practical interest, and very often the two are combined. Lymphangitis begins earlier—as a rule between the second and the fifth day; phlebitis, more commonly at or after the end of the first week. Lymphangitis is accompanied by pain in the lower abdomen; in phlebitis there is hardly any. In lymphangitis even a slight pressure on the abdomen provokes it; in phlebitis there is no tenderness of the abdomen, and the tender veins in the pelvis have to be sought with care. In lymphangitis there is a large uterus; phlebitis interferes less with involution. Lymphangitis spreads rapidly upward, and may cause peritonitis, pleurisy, pericarditis, and hypostatic pneumonia. It does not cause inflammation in the head or the limbs, nor infarctions and abscesses of the viscera. Lymphangitis begins commonly with a chill, but the repeated chills are characteristic of phlebitis. In lymphangitis the fever is more steady; in phlebitis there are marked and long intermissions.

ENDOCARDITIS.

The inflammation of the endocardium is a late puerperal affection. It appears between ten and fifteen days after delivery. It is marked by an exasperation of the febrile symptoms, but can only be recognized by means of auscultation, which reveals a harsh, rasping sound, especially at the apex, but sometimes at the base. Mostly it is synchronous with the first sound, but may also accompany the second. A peculiar feature of puerperal endocarditis is the mobility of the auscultatory

signs : one day their seat may be the mitral valve, the next the semi-lunar valves, and *vice versâ*.

The endocarditis is mostly necrotic. When the small infectious abscesses open into the current of the blood, their contents—microbes and their products—are carried throughout the system and form new localizations; but the symptoms of this new infection are overshadowed by those of the original one starting from a uterine phlebitis.

The endocarditis makes the PROGNOSIS still worse than it was before.

THE ALIMENTARY CANAL.

The alimentary canal is not much affected by puerperal phlebitis. We have, however, noticed the anorexia, thirst, occasional vomiting, and frequent diarrhoea. Sometimes thrush appears on the dry tongue.

We have likewise mentioned the occasional localization in the tonsils, the parotid gland, and the thyroid body. They are all late in appearance, and make the prognosis worse.

HEPATITIS.

The liver is very frequently more or less affected. There may be pain in the right hypochondrium; tenderness on pressure; an enlargement that can be demonstrated by percussion and palpation; sometimes real jaundice; and always a yellowish color of the skin. If there is peritonitis, the serous cover of the liver may be implicated. Sometimes this perihepatitis may be recognizable by the crepitation felt on pressure.

NEPHRITIS.

The kidneys are very often inflamed and contain abscesses. The only reliable symptom is the presence of albumen and casts in the urine. The other symptoms, such as headache, visual disturbances, vomiting, and lumbar pain, become mostly so merged in the general condition that they cannot be isolated and used as diagnostic symptoms. A persistent tenderness on pressure may make us think of a perinephritic cellulitis.

SPLENITIS.

The inflammation of the spleen may sometimes be diagnosticated by the increase in the size of the organ found by percussion and palpation. There may be pain and tenderness on pressure in the left hypochondrium. If an abscess opens into the abdominal cavity, it causes collapse and death. Mostly, the symptoms belonging to the affection of the spleen are merged in those of other organs and the general condition.

NERVOUS DISTURBANCES.

The nervous system is much affected in childbed. There may be neuralgia, paralysis, convulsions, tetanus, tetany, insomnia, delirium,

carphology, etc. Often these conditions find their explanation in cerebral anæmia or hyperæmia, in hysteria, in reflexes, or in direct pressure on a nerve during the birth of the child. But when these conditions are found together with symptoms undoubtedly due to infection, or when the autopsy shows thrombosis of the veins of the brain or purulent meningitis, we cannot otherwise than acknowledge a connection of cause and effect between the infection and the nervous disturbances.

ARTHRITIS.

The localization sometimes takes place in joints. As a rule, only one or a few are affected, although many may be so from the first; but the disease does not jump from one joint to another, as does inflammatory rheumatism. The joint becomes swollen, tender, and red; every movement causes intense pain; there is a great tendency to suppuration; the abscess may open through the skin; and the deepest structures, bone and cartilage, may be destroyed. If the patient survives, she may have a stiff joint for the remainder of her life. The knee is most frequently the seat of the affection, but it may attack any other articulation of the limbs. Of those of the trunk, the symphysis pubis, the sacro-iliac, and the sterno-clavicular joint are most frequently inflamed. The synovial sheaths of tendons may be similarly affected.

DIAGNOSIS.—The fixity and the tendency to suppuration, besides the concomitant disturbances, distinguish puerperal arthritis from common rheumatism and gonorrhœic arthritis.

ABSCESS AND DIFFUSE CELLULITIS OF THE LIMBS.

When the subcutaneous and intermuscular connective tissue becomes inflamed, the limb swells; it is painful and tender; the skin becomes red and hot. The affection may be localized in one or more circumscribed points, where abscesses form and perforate the skin; or there may be a diffuse cellulitis extending over a large part of a limb. Sometimes it is only superficial, having its seat in the subcutaneous tissue. In other cases the deep connective tissue under the fascia is in a similar condition, and especially then the process may be highly destructive to life or limb if an energetic treatment is not resorted to in time.

SKIN DISEASES.

A puerpera may be attacked by the common eruptive fevers—measles, smallpox, scarlet fever, and erysipelas—just as any other woman. They are accidental complications which are not essentially connected with childbed.

Perspiration being a feature of the normal childbed, we sometimes see in women who otherwise are well the epidermis raised in small

white vesicles like millet-seed (*miliaria*), with or without a red ring at the base or on continuously red skin. This miliary eruption is mostly found on the trunk.

It goes without saying that the common drug eruptions may as well appear in a puerpera as in any other person.

I have likewise seen an eruption, composed of small red papules and red streaks, especially on the extremities and in the face, much like measles. After a few days it was succeeded by a uniform erythema. It was accompanied by moderate fever and followed by a *furfuraceous* desquamation. After a few days there came a similar eruption. This and the total absence of catarrhal phenomena proved it to be different from measles.

In another case I have seen a similar papular eruption with a temperature of 105° . It began as maculæ that vanished on pressure, but reappeared immediately. Later it became papulous, and did not disappear on pressure. After a week it faded gradually, sank down to the level of the skin, passed through divers shades of yellow, until it finally disappeared. No other signs of puerperal infection were present.

In grave cases of puerperal infection the skin is often the seat of eruptions. An erythema may spread more or less far from the genitals. In other cases large erythematous spots may be found on divers places of the trunk and the extremities. In others, again, are found petechiæ, small dark-red or brown spots about the size of hempseed, which do not disappear on pressure. These I have only seen in very serious, mostly fatal, cases.

In other cases the epidermis is raised in large pemphigus-like vesicles, or forms bullæ filled with pus which burst and leave a sore.

In all these eruptions which accompany a general infection the symptoms referable to other organs mostly cover those due to the skin affection.

ACUTEST SEPTICÆMIA.

This form of puerperal infection used especially to be found during the so-called epidemics in hospitals. Nowadays it has become rare, and is never seen in well-directed institutions. It begins soon after delivery with an intense and long chill. There is no pain or only an insignificant one, and no swelling of the abdomen. The face has an anxious expression. The skin is pale or purplish, the tongue dry and brown, the features pinched. The pulse is rapid (120 to 160) and weak. The temperature may be high (104°), and stay high without the usual remittance, but it may be normal or even subnormal. The respiration is rapid. The patient falls often into a delirious or comatose condition. She has frequently involuntary evacuations of a thin,

dark, offensive discharge from the bowels. The urine is scant and loaded with albumen.

The patient dies within a day or two after confinement.

TREATMENT.

In laying down rules for the treatment of puerperal infectious diseases we have to distinguish between hospital and private practice, the prophylactic and the curative treatment. As the curative treatment is essentially the same in hospitals and in private dwellings, it is only the prophylaxis which we will consider separately with regard to the peculiar circumstances obtaining in hospitals and the demands of private practice.

I. PREVENTION OF PUERPERAL INFECTION IN HOSPITALS.

The Hospital.—If possible, lying-in hospitals should be, as they now mostly are, separate institutions, without connection with a general hospital in which medical and surgical diseases are treated. Before the antiseptic treatment had been generally adopted in midwifery the mortality reigning in the obstetric wards of general hospitals was still greater than that of institutions exclusively used for parturient and puerperal women. It could not be otherwise when doctors and students went from performing an autopsy in the dead-house to delivering a woman in labor, keeping on the same clothes and only washing their hands in a more or less superficial and entirely insufficient way. By the conscientious and intelligent use of antiseptics a total change has taken place in this respect. Still, as we know that puerperal infection may be derived not only from women affected with the same disease, but from patients with suppurating or decaying tissues, from all putrefying substances, and perhaps from persons suffering from zymotic diseases, and as the rules given for the safe aseptic and antiseptic treatment of the parturient and puerperal woman may not in every instance be carried out with the same degree of precision, it is evident that patients taken care of in an institution solely consecrated to obstetric cases, other things being equal, are better protected against infection than those who are delivered in the wards of a general hospital and by the same physicians who have charge of the other cases.

The New York Maternity Hospital is, so to say, placed midway between the special lying-in institutions and the general hospitals with lying-in wards. We have a separate building, and we have a house staff who for the time being have nothing to do outside of the hospital. But, on the other hand, the visiting physicians are general practitioners, whose pursuits bring them in contact with all sorts of diseases. The

house physicians come from the staff of Charity Hospital, a large general hospital, and serve only six weeks at a time in the capacity of junior assistant, senior assistant, and house surgeon. The nurses are pupils of the training-school which is common for Maternity and Charity Hospitals. The warden, the higher administration, the ladies' visiting committee, the helpers that carry coal, food, and scrub the floors, are common for both institutions. Taking all these unfavorable circumstances into consideration, we cannot expect, in spite of the most perfect rules for antiseptic treatment, to obtain quite as good results as in institutions that have no connection with general hospitals, and in which the service is uninterruptedly for many years in the hands of one man with a few assistants, who likewise occupy their positions for years and become experienced obstetricians themselves, capable of replacing their chief even in the performance of the most dangerous operations.

Even after the strict antiseptic treatment presently to be described had been in use for three years in the Maternity Hospital, I had the opportunity to see how dangerous the connection with Charity Hospital may become if the slightest relaxation occurs in the observance of the rules governing the relations between the two hospitals. Between September 6, 1885, and January 16, 1886, we had no less than 13 cases of puerperal diphtheria in about 200 confinements. Several of them were very severe, and 1 ended fatally. It made a particularly strong impression on my mind that when a new staff went on duty on the 1st of January, out of their first 6 patients 3 were affected in this way. I then found out that, without my knowledge and against the rules, the house surgeons had fallen back to the old habit prevailing before the new treatment was introduced, of allowing members of the Charity Hospital staff not only to visit the delivery-room, but even to deliver parturient women in the Maternity Hospital. As soon as this was discontinued, and the members of the Maternity staff had taken full baths with corrosive sublimate and had their clothes fumigated with sulphur, all septic trouble disappeared again, and since then there have only been a few isolated cases with long intervals.

A lying-in hospital should have as free access of pure air as possible, and it should circulate freely under the building, whether the latter be provided with a cellar throughout its length and breadth or it be raised from the ground on pillars. If the available means allow it, a good system of ventilation should be introduced. I have been informed by a competent architect that the only way to obtain fresh air in the wards of a hospital is by the so-called fan system, according to which large fans are driven by steam and throw the air from the cellar through openings into the wards. In winter-time it is heated before being moved by the fans.

In the Maternity Hospital, where we have no ventilating apparatus, we keep the windows open day and night, summer and winter. Although this interferes somewhat with the normal perspiration after childbirth, we have never seen any bad effect from it in the patients, but it is hard on the poor nurses.

Even the smallest lying-in hospital should have separate wards or rooms for patients with infectious diseases. If no such provision is made until disease actually breaks out in the institution, the first case or cases, especially if of a lighter type, are liable not to be isolated, and thus a so-called epidemic of puerperal fever may be started.

There ought likewise to be made provision for a rapid rotation in the use of different wards, in order that they may be disinfected before being used again. Even before the introduction of the new treatment in the Maternity Hospital, when we used the wards in a haphazard way, we always found that when we had a ward emptied, cleaned, and fumigated the patients in that ward were free from fever during the first week after the cleaning. Now a regular rotation in the use of the wards is an important part of our treatment. Our wards can accommodate respectively six and nine patients. A ward is not used for more than one set of patients: when the last of them has been there until the ninth day after her confinement the ward is disinfected in a way to be described hereafter, and left empty for one or more days. On the ninth day the patients are transferred to the convalescent ward, where they only stay a few days longer unless some pathological condition requires a longer sojourn in the hospital.

Pregnant women ought to be kept separate from parturient and puerperal women, and are so in our institution. They require other food; they are not so clean; they would disturb the quietude that reigns in the lying-in wards; and the sight of suffering would have a demoralizing effect on themselves.

There ought to be a special delivery-room. As it is commonly during parturition that infection takes place, a patient ought never to be confined in a ward in which there are puerperal women who might become a source of infection to the one in labor.

The communication between the delivery-room and the wards should be as easy as practicable, so as to avoid carrying the patient a long distance after her delivery. But, if possible, there should be no direct communication between them nor between the different wards. This system is followed in Tarnier's model pavilion in Paris, and was introduced by me in Maternity Hospital together with the change of treatment which took place on the 1st of October, 1883.

Good results may be obtained with another disposition of the localities, but where it can be obtained this one is preferable. No bad air can be diffused from one ward to the other. There is no temptation

for carrying materials and vessels from one to the other, each forming a little world by itself. Doctors and nurses are obliged to be exposed to the purifying influence of the open air in going from ward to ward. In the Maternity Hospital I had the doors leading from one room to the other locked and sealed by filling all chinks with tow and covering this with strips of rubber adhesive plaster.

The wards ought to have plenty of light from opposite sides. The beds are best distributed in two rows or in a circle, one on each pier between two windows. Light from above is of no value except in an operating-room, and all cross-beams and projections which would become receptacles for dust ought to be avoided. Disease-germs are well preserved in such dust, from which they may find their way to the patients.

Floors and walls should be of a hard, smooth, little-porous material, so that they can easily be disinfected.

Where circumstances permit it is good to set one or more small rooms apart for serious operative cases.

The question of heating the hospital is an important and difficult one. I think some combination of different principles is advisable. Steam circulating in iron pipes is good to give a large and constant amount of heat, and is necessary in order to prevent the water from freezing in the pipes. Open fires are cheerful to look at; the rays of heat emanating from them give a pleasant sensation, which cannot be replaced by anything else; they purify the air in the ward by drawing it into the chimney; and it is a handy way to get rid of small dirty objects which otherwise might accumulate in the ward. Stoves are more economical, and can in most respects replace the open fires, but if overheated they exhale an unpleasant and unhealthy odor.

The new Maternity Hospital is to have the shape of a cross. A large delivery-room forms the centre of the whole establishment. From this go off three wards, with ten beds each, toward the south, east, and west.¹ Between the delivery-room and the wards there will be open porches, which will allow free circulation of air and make it possible for the physicians to get all over the establishment without passing through the delivery-room. At the northern end there will be a room for the doctors, one for the head-nurse, and two for operative cases. At the southern end there will be four rooms for infectious diseases, each for one patient. Each ward and the department for infectious cases have their own little kitchen for warming food, making poultices, and so forth, their own bath-room, sink, and water-closet, outside of the ward.

¹ So was the distribution on the plan the architect made under my direction. A higher power has turned the building ninety degrees, which gives the doctors and the nurses the exhilarating morning sun, and leaves half of the isolating rooms, in which the most serious cases are treated, exposed to the cold north winds.

The waiting women and the convalescent women will be in separate buildings, as they now are.

The department of a lying-in hospital destined for infectious cases ought to have separate beds, furniture, and instruments. The patients ought to be under the care of special nurses and a special house physician. The visiting physician ought to be the only one who attends to the whole service.

Water-closets ought to be of the very best and simplest construction, and never situated in the wards. To screen them off with a few boards, as is sometimes done, is of course a nearly imaginary precaution. They ought to be placed not only outside of the wards, but separated from the latter by a space to which open air has free access. Both doors intervening between the ward and the water-closet ought to close automatically; otherwise they will be left open by patients and nurses.

Provision must be made for a place to disinfect all linen and bed-clothes used by patients with infectious diseases before they are washed in the common laundry of the hospital.

As the women commonly stay only a very short time in the hospital after their delivery, and as a lying-in room ought to be kept as quiet as possible, no visitors ought to be admitted except in protracted cases. Most of such visitors would come from crowded tenement-houses, in which very often are found diphtheria, scarlet fever, and other zymotic diseases, the germs of which might be brought to the hospital.

The house staff ought never to make autopsies, handle specimens, or even enter the dead-house; nor ought they to be allowed to visit hospital wards in other places in which sick people are confined.

Disinfection.—The marvellous results obtained in lying-in hospitals nowadays are chiefly due to cleanliness and antisepsis. A nail-brush has become the most indispensable of all obstetric instruments. In order to give practical rules for disinfection, and abstain from vague generalities which are unfit to guide anybody, I do not think I can do better than describe minutely how it is carried out in the Maternity Hospital.

The principle upon which we act is the theory that infectious diseases are due to germs which may be found on the surrounding objects, in the air, on the patient herself, on the doctors and nurses. We will therefore have to consider the disinfection of the wards and furniture, of the patient and her helpers, and of all materials or instruments that come in contact with her.

Ward.—When the last patient admitted to a ward has reached the ninth day after her confinement, it is fumigated by burning twenty pounds of sulphur in the smaller and thirty pounds in the larger wards. This is done in an apparatus made of iron and composed of two horizontal pans connected by means of three uprights about half

a yard high. The sulphur is placed in the upper pan and moistened with alcohol. The lower is filled with water, which would put out the fire if the sulphur got through the bottom of the upper pan. All windows and doors are closed and the alcohol lighted. From half a day to a day later the doors and windows are opened, and, if the ward is not needed immediately, they are left open for one or more days. The floors and all the furniture—bedsteads, tables, chairs, etc.—are scrubbed with soap and water, and thereafter again scrubbed with a solution of bichloride of mercury, 1 part to 1000 parts of water. As soon as a patient leaves the lying-in ward the bed-clothes, inclusive of the ticks of the mattresses, are sent to the laundry, and the straw in the mattresses is burnt. When the ward has been fumigated and washed all the beds are made up with clean clothes and fresh straw. Bed-clothes used by sick puerperæ are immersed for an hour in the same bichloride solution in large casks placed in the small room between the sick ward and the water-closet, and given a preliminary washing before they are sent to the laundry. Patients and nurses use only clothes that can be washed. If doctors want theirs disinfected, it is done with sulphurous acid by suspending them in a room in which sulphur is being burned.

Patient.—When a patient is taken in labor she is given a full tepid bath and scrubbed with soap. In order to remove still more effectively the fatty film covering the epidermis, it might be good to add soda to the soap and water with which she is washed, as recommended by Fritsch.¹ After the bath she is dressed in clean clothes and placed on a clean bed, under the sheet of which is placed a rubber sheet disinfected with bichloride (1 : 1000). She is given an enema of soapsuds. Her abdomen, thighs, buttocks, and especially all the sulci at and near the genitals, are carefully washed with bichloride (1 : 2000). About two quarts of the same fluid used to be injected into the vagina, but has of late been replaced by a 2 per cent. solution of creolin.

While all agree as to the necessity of disinfecting the patient's skin, opinions differ in regard to the advisability of using the vaginal injections. Thus, Fritsch² is opposed to them, except on special indications (leucorrhœa, gonorrhœa, fever). He thinks they are not only useless, because the bacteria found in the vagina are innocuous, and the vagina, on account of its numerous folds, cannot be disinfected by injections, but even dangerous, in so far as they remove the mucus that makes the vagina soft and slippery. All this does not convince me. I do not think it practicable while attending a woman in labor to decide what kind of bacteria are found in the vagina, and I fail to see why we should do less to remove them from the latter than from the skin and the vulva. I take it to be very desirable to

¹ H. Fritsch: *loc. cit.*, p. 127.

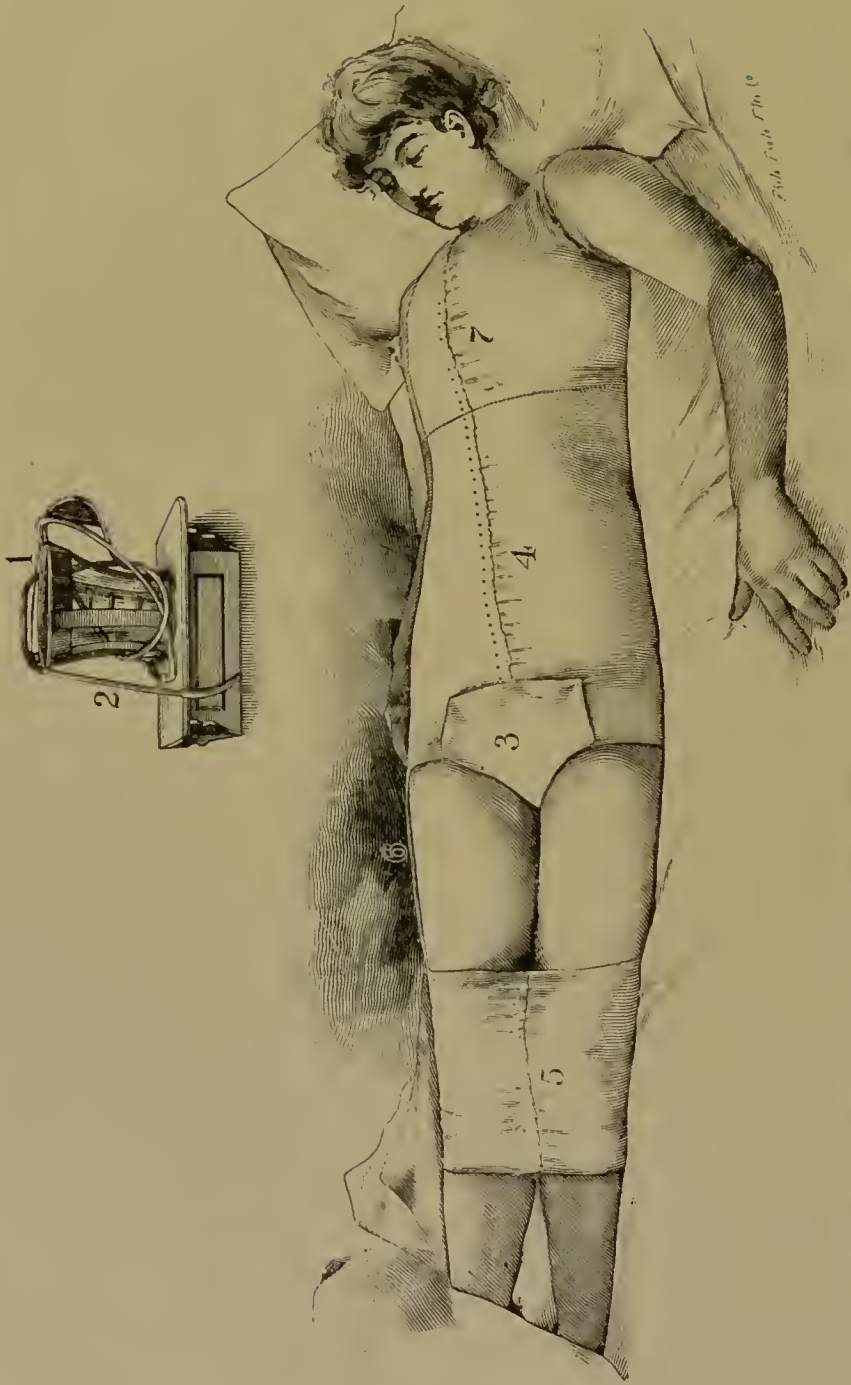
² *Loc. cit.*, p. 129.

have the vagina as well disinfected as possible. We must remember that during examinations mucus is carried from the vagina into the interior of the womb, which has an entirely different epithelium and numerous lymphatics that absorb with great ease. During the passage of the child the vagina itself is enormously distended and becomes the seat of abrasions and tears. Germs which were harmless on the intact surface of the vagina might therefore be pressed into the tissue and give rise to disease. Injections may not accomplish a perfect disinfection, but when the patient is lying on her back, raised on a bed-pan, and the nozzle of the syringe is brought 'way up to the vault of the vagina, it takes quite a little time before the water flows out, and a large amount is retained. It distends the vagina, enters the folds, and bathes the ridges. It is true that the water with its astringent qualities removes the mucus and hardens the walls of the vagina, but new mucus is secreted in such quantities that we can see it flow out in front of the presenting part. I think, therefore, that all we have to do is to abstain from too frequent injections during labor, and especially toward its end. A first good cleansing by means of disinfecting fluids is, in my opinion, a useful safeguard against infection.

The injections are made by means of fountain syringes of agate-ware. At first I had them made of glass and set in metal cradles, as shown in Fig. 100, but the manufacturers soon refused to take the trouble to make them, the demand being so small. Then I introduced thick glass irrigators with handles which are imported from Germany, but they are expensive, and we soon found that they cracked near the handle when hot water was poured into them. Of late I have had cans of agate-ware altered for our purposes. They come into the market destined for beer-measures, and hold nearly two quarts. A strip of glass in the side allows one to see the level of the water. I ordered a hole drilled near the bottom and a curved hard-rubber tube cemented in it. To this a soft-rubber tube is fastened, and at the other end slipped over a common straight glass tube about six inches long, for vaginal injections. The common soft-rubber bags are less good for hospital use, because it is impossible to wipe off their interior and it takes more time to fill them.

Doctors and Nurses.—If there is slight divergence of opinion as to the amount of disinfection to be applied to the patient, all agree about the importance of a thorough disinfection of the accoucheur himself. He ought to take off his coat and cuffs, roll up the sleeves of his shirt and undershirt, and clean and disinfect his hands mechanically and chemically. It is not enough to use soap and rub our hands a little against one another, as in ordinary cosmetic washing. The whole hand must be carefully scrubbed with a stiff nail-brush, the doctor taking particular

FIG. 100.



1, douche can ; 2, intra-uterine tube ; 3, occlusion dressing ; 4, belly-binder ; 5, knee-binder ; 6, suspenders ; 7, breast-binder.

care to scrub the spaces under the nails and the creases at their root—localities from which dirt is removed with greater difficulty than from the smoother parts of the hands. By this mechanical cleansing extraneous dirt and dead epidermis-cells are removed from the skin. After the washing the hands are wiped dry, and the spaces under the nails carefully scraped with a suitable instrument. Common penknives are too sharp: they are apt to deprive the inside of the nail of its smoothness, and even to cut the skin. Scrapers of bone are not sharp enough. An excellent steel scraper is that patented by Curley and found in some of George Wostenholm's pocket-knives. It removes the dirt with ease and rapidity, and cannot wound the finger.

Thus prepared, the hands are immersed for at least three minutes in a solution of bichloride of mercury (1 : 2000), in which the scrubbing may be repeated.

Since corrosive sublimate loses some of its antiseptic properties by being mixed with soap,¹ the cleansing and disinfection ought to be, as here described, two separate acts; and it is not good, as some recommend, to wash the hands with soap in the solution of corrosive sublimate.

If we have the choice, the best kind of soap for disinfection is the soft potassa soap. It possesses, in fact, itself considerable antiseptic properties. Robert R. Koch,² than whom there is no higher authority in bacteriology, found that a solution of 1 : 5000 began to hamper the development of bacilli, and that one of 1 : 1000 prevented it completely. In my opinion, we cannot have a better proof of the high practical value of this soap as an antiseptic than the excellent results obtained in the large lying-in hospital of Vienna, where they have had a series of five hundred confinements without a death³ [from sepsis?]. Since the standard antiseptic used in that institution is only a 1 to 2 per cent. solution of carbolic acid,⁴ which has been proved experimentally to possess very weak antiseptic properties, it would seem that the results obtained are due more to the soap than to the carbolic acid. This soap has, indeed, other virtues besides that of being a germicide. It is so sticky that once smeared over the skin it is very difficult to remove, and in doing so the accoucheur gets cleaner hands than with the more or less hard soda soap in common use. It is likewise the cheapest of all soap when not bought by the ounce in the drug-stores as an ointment used in skin diseases.⁵

¹ Dr. Boxall: *New York Medical Record*, 1888, vol. xxxiv. p. 481.

² R. R. Koch: "Ueber Disinfection," in *Mittheilungen aus dem kaiserlichen Gesundheitsamte*, 1881, vol. 1. p. 271.

³ Kueher: *Puerperal Convalescence, and the Diseases of the Puerperal Period*, New York, 1886, p. 236.

⁴ Ehrendorfer: *Archiv für Gynäkologie*, 1885, vol. xxvii. p. 218.

⁵ The soft soap made in this country is of a dirty greenish-yellow color. I do not know if it possesses the same germicide power as the green German soap used in Koch's experiments, but it possesses the same stickiness and its wholesale price is only six cents.

For a mere examination or for a normal delivery it is sufficient to disinfect the hands in the manner described, but in any kind of operation, and especially in that of turning, both arms ought to be disinfected up to the elbow.

If the accoucheur has had to deal with a case of puerperal fever, diphtheria, scarlet fever, or other disease liable to infect the patient, he ought even, if possible, to take a full bath with two drachms of bichloride, and wash his hair and beard with great care while he is in the bath. Under similar circumstances we ought likewise to take particular precautions in regard to our hands, such as to scrub them still more thoroughly, to use a stronger solution (1 : 1000), and to hold the hands longer in it, say five minutes. A common disinfection takes at least five or six minutes; after having been particularly exposed the doctor ought to devote no less than ten minutes to this all-important act.

By the process described the hands are efficiently disinfected, but we must remember that merely by putting the hand into the pocket in order to take out and replace the nail-cleaner, or by touching towels, bed-clothes, and other objects before introducing the finger into the genital canal, fresh infectious matter may adhere to it. We have, therefore, standing at the bedside, a basin with lukewarm solution of bichloride (1 : 2000), in which we immerse the hand the very last moment before bringing it in contact with the genitals.

Nurses ought to disinfect themselves with the same care and in the same way as physicians.

Materials.—All materials coming in contact with the genitals, such as absorbent cotton, lint, etc., are wrung out of the same solution of bichloride before being used.

Instruments, especially when nickel-plated or made of silver or tin, are more or less corroded by corrosive sublimate. They are therefore disinfected with carbolic acid. For a rapid disinfection it ought not to be used in a weaker solution than 5 per cent., but during an operation it is sufficient to have a $2\frac{1}{2}$ or 3 per cent. solution. Since both instruments and the hands of the surgeon are attacked by carbolic acid—the latter in my experience much more so than by bichloride—an unnecessarily strong solution should be avoided. After operations the instruments should be carefully scrubbed with soap and water and carbolic solution, and rinsed with plain water. Complicated instruments must be taken apart. For Simpson's axis-traction forceps it is necessary to have a key made if it does not come with the instrument, by means of which the traction-rods can be unscrewed after each operation, and the joint, to which blood and other fluids find access, be thoroughly cleansed and disinfected.

In ordinary labors *sponges* are superfluous, and so dangerous as

carriers of septic matter that they ought to be absolutely ostracized. Even in minor operations, such as perineorrhaphy, they are replaced by absorbent cotton and lint wrung out of the 2 per cent. solution of creolin or carbolic acid. In laparotomies they can hardly be entirely dispensed with, although their use may be much limited by substituting pads of gauze wrung out of the antiseptic solution.

If sponges are used, the utmost care must be bestowed upon their disinfection. New sponges, as they come on the market, need a good deal of hammering and washing to remove sand and make them soft. Even if bought thus prepared, they often contain calcareous incrustations which are dissolved by immersing the sponges for an hour in a weak solution of hydrochloric acid, one ounce to every quart of water. After that they must yet be wrung out of water as long as any sand comes out of them. Next they are left for an hour in bichloride of mercury (1 : 1000), wrung out, dried by exposure to heat, and kept in a muslin bag for future use.

If old sponges are to be used again, they may be cleaned and disinfected in different ways. The way I do is to wring them out in warm water till it remains entirely colorless and apparently pure. Then I leave them for an hour in a solution of potassa (liquor potassæ 3j to each quart of water), which draws out all the blood. In exceptional cases, when the sponges have become very much saturated with blood, it may become necessary to change this solution. They are then wrung out of plain water until it remains entirely colorless, and disinfected with corrosive sublimate as above.

By keeping the sponges dry they do not rot so rapidly as when kept in carbolized water. Before the next operation they are left for a short time in a strong solution of bichloride (1 : 2000), wrung out, and kept in a weak solution (1 : 5000 or 10,000) of the same, or in carbolized water (2½ to 3 per cent.), during the operation.

For *sutures* and *ligatures* I prefer silk. It is easily obtained, easily made aseptic, and easily tied. It is hardly safe to rely on the silk sold as aseptic in the shops: the operator must take the trouble to prepare it himself. Some of the busiest surgeons in the world find time to do this, and take particular care in examining the material. I prepare my silk by boiling it in a china casserole for half an hour, immersing it for another half hour in a solution of corrosive sublimate (1 : 1000), and keeping it wound on glass spools in well-corked glass bottles filled with alcohol.

Catgut takes much more time to prepare. One of the speediest methods is that of Koehler. The raw catgut as found in the shops is immersed for twenty-four hours in juniper oil; that is, the oil gained by distillation from the unripe fruit of *Juniperus communis*. That procured from the tops or wood is an inferior article, not fit for our pur-

pose. At the end of the time indicated the catgut is rinsed with and kept in alcohol.¹

For some operations, such as suturing the uterine after the Cæsarean section, if catgut is at all used, it is necessary to have some that will resist absorption longer than common catgut. Such a preparation is Lister's chromicized catgut. It is prepared by dissolving 1 part of chromic acid in 4000 parts of distilled water, and adding 200 parts of carbolic acid. Catgut equal in weight to the carbolic acid is left for forty-eight hours in the mixture. The preparing fluid causes a certain amount of softening and uncoiling of the twisted cord, and a still greater degree of uncoiling takes place during drying. This may lead to the gut giving way when subjected to a strain. It ought therefore to be dried on the stretch by tying the ends of each hank to two fixed points in the room. When dry it is placed in 1 : 5 carbolic oil. Erosion of this catgut does not begin till about a fortnight after its introduction into the tissues.²

Silver wire is disinfected by immersion in alcohol or by passing it through the flame of an alcohol lamp.

During an operation all ligatures and sutures are kept on plates with alcohol.

Iodoform is used to advantage in several obstetric operations. A torn perineum may be powdered with it before the sutures are closed. After Cæsarean section the wound in the abdominal wall may be dusted with it and covered with iodoform gauze. Much surprise was caused in 1887 by the discovery of Heyn and Rovsing of Copenhagen³ that iodoform did not prevent the development of bacilli in artificial cultures, but it seems that it is decomposed by the very appearance of pus-cocci and the formation of ptomaines in such a way as to become a germ-killer.⁴ However the theoretical explanation may turn out, experience has abundantly proved that iodoform is a most valuable preventive of suppuration and sepsis.

The value of the preventive antiseptic treatment is proved by the unanimous testimony of all institutions that have adopted it. Both as to mortality and morbidity the most remarkable change has taken place. As late as 1875 the International Congress of Physicians declared that large lying-in hospitals ought to be abolished; to-day the mortality of some of the largest has dwindled down to be a fraction of 1 per cent.; and if we compare the results obtained in private houses and in hospitals among the class of patients who seek admission to the

¹ Wood and Bache: *U. S. Dispensatory*, 13th ed., 1874, p. 1308; *Hospital Formulary of the Department of Public Charities and Correction*, 3d ed., 1886, p. 96.

² W. Watson Cheyne: *Antiseptic Surgery*, London, 1882, p. 57.

³ *New York Med. Record*, 1887, vol. xxxii. p. 36.

⁴ *Centralblatt für Gynäkologie*, 1887, vol. xi. pp. 514, 515.

latter, they are much better in hospital than in private practice. Especially for dangerous operations, such as Cæsarean section, craniotomy, and the removal of the adherent placenta, hospitals have become the safe places where obstetric art celebrates its greatest triumphs.

The records of the Maternity Hospital show the following mortality before and after the introduction of strict antiseptic (bichloride of mercury):

Year.	Deliveries.	Deaths.	Per cent.
1875	570	15	2.63
1876	536	20	3.73
1877	480	32	6.67
1878	255	7	2.75
1879	254	11	4.33
1880	149	8	5.37
1881	382	9	2.36
1882	431	14	3.25
1883	447	30 ¹	6.71
Total	3504	146	4.17

During the last six months, before the change in treatment was made, there were delivered 237 women, 19 of whom died, or 8 per cent., and of these 17, or 7.17 per cent., succumbed to sepsis. During the last month the total mortality reached even 20 per cent., and that from infection 15.69 per cent.

During the first three months after the change, from October 1, 1883, till January 1, 1884, we had 102 deliveries without a single death. From that time the mortality has been as seen by the following list:

Year.	Deliveries.	Deaths.		Per cent.	
		Total.	From Sepsis.	Total Mortality.	Sepsis.
1884	522	8	4	1.53	0.76
1885	537	3	0	0.56	0.0
1886	446	5	1	1.12	0.22
1887	389	5	1	1.30	0.26
1888	377	3	0	0.79	0.0
Total	2271	24	6	1.06	0.27

Thus the total mortality has become little more than one-fourth of what it used to be; and while in former years the cause of death was nearly always some form of disease which we now regard as due to infection, *deaths from sepsis have now been reduced to nearly one-fourth of 1 per cent.* During the years 1885 and 1888 there was not even a single death of this kind.

No less remarkable is the change in regard to morbidity. Thus, for instance, during the six months from October 1, 1882, till April 1, 1883, a period of which I have exact notes, 192 women were delivered. Of

¹ All these occurred in patients delivered during the first nine months of the year.

these 46, or *nearly 1 out of 4*, were seriously ill, and 39, or nearly 1 in 5, suffered from puerperal inflammation, which nowadays, at least, is subject to grave suspicion in regard to infection. Since the change in treatment we have had very few sick puerperæ, and with few exceptions the cases have been mild. We have every year had cases which, from all symptoms, such as pain, tenderness, and swelling, had to be diagnosticated as cellulitis, and still the thermometer showed no rise in temperature—a phenomenon which I can only account for by supposing that the inflammation was of purely traumatic origin, due to the bruising of the genital canal by the passage of the child, and that the aseptic way in which labor is conducted, as well as the precautions we take during the lying-in period, excludes all infectious germs which develop so easily in bruised tissues.

At the hour of writing it is just five years since I introduced the bichloride-of-mercury treatment in the Maternity Hospital. During that time it has been kept up without any change, and the results have been so satisfactory that I feel very little inclined to make any. Still, it may become necessary to substitute another antiseptic for the bichloride used in injections. So many cases of death from *poisoning* by this drug have been reported that the subject demands our most serious and conscientious consideration. In many of these cases unreasonably strong solutions or an unjustifiable amount of fluid was used. Protracted irrigation of wounds has proved particularly dangerous, both by clinical observation on men and by experiments on animals.¹ An anæmic condition of the patient makes absorption stronger, and therefore increases the danger of poisoning. But even when all precautions were taken, and in healthy patients, poisoning has occurred. The most remarkable case I know of is that reported by Fleischmann from Breisky's clinic in Prague.² In 1620 confinements they had used bichloride without any poisoning, when the following sad case occurred: The patient was a primipara, seventeen years old, in good health, and especially without any symptoms of kidney disease. Before and immediately after an examination the vagina was douched with a liter (little more than a quart) of a 1 : 2000 solution of corrosive sublimate. It was noticed that after the first injection there came a little bloody discharge from the genitals, probably due to granulations of the cervical portion. These two injections given before delivery were all she got, and still she developed symptoms of poisoning immediately after, and died a week later. The autopsy revealed the pathognomonic calcareous deposits in the kidneys and diphtheritic ulcers in the intestinal canal. In Berthod's case³ death occurred, although only six

¹ Doléris and Butte: *Nouvelles Archives d'Obstétrique et de Gynécologie*, 1886, p. 739.

² Fleischmann: *Centralblatt für Gynäkologie*, 1886, vol. x. p. 761.

³ *Centralblatt für Gynäkologie*, 1887, vol. xi. p. 768.

vaginal douches and one intra-uterine injection of a 1 : 2000 solution had been given. The autopsy showed nephritis and intestinal ulcers.

At one time it was thought that only the intra-uterine injections caused the evil, but the above case from Breisky's clinic and observations of O. von Herff of Darmstadt, G. Braun, and others¹ prove that the vaginal injections are by no means free from danger. The same is, to some extent, corroborated by the experiments of Doléris and Butte on animals.

Personally, I have never had a fatal case of bichloride-poisoning in my hospital service, and I have only seen one case showing symptoms undoubtedly due to the toxic effect of this drug. In that case there was soreness of the gums and salivation—a symptom which, strangely enough, is said to be rarely found in cases of poisoning by injections and similar procedures (Butte). The few other cases I have seen were in women affected with “puerperal fever;” and as the only symptoms were bloody diarrhoea and intestinal tenesmus, which might be due to the disease itself, it is really not said they were produced by the use of bichloride. But, seen in the light we now possess, I strongly surmise that one or two cases of death that have occurred in the Maternity Hospital were unrecognized cases of poisoning with bichloride. Thus, the following résumé of a case has been furnished me from the books of the hospital: M. D—, æt. 28. Placenta expelled spontaneously, together with child. Following delivery the patient had watery discharges from the bowels—*twenty-nine during the first two days*. Vomiting. No fetor to lochia. Clinical diagnosis, dysentery. Patient died. Autopsy was not allowed.

Last fall I saw in consultation the following case of fatal poisoning by corrosive sublimate. The patient was thirty-five years old, robust, a primipara. The os began to dilate toward the night of October 1, 1888. As on the next morning it had barely reached the size of a fifty-cent piece, the physician introduced two fingers into the cervix and assisted dilatation as much as possible. When this was accomplished, he delivered by means of the high-forceps operation at 2 P. M. When the patient was put in bed all outer parts liable to be touched during delivery had been disinfected with a solution of bichloride 1 : 2000, but no vaginal douche had been given. After completion of labor one gallon of a 1 : 4000 solution of bichloride of mercury was prepared, and one ounce of carbolic acid added to it. The vagina was syringed out with part of this fluid, and the tube passed into the womb. After a very few moments the patient complained of abdominal pain, and slowly passed into the condition of syncope, followed by clonic muscular contractions of the limbs. Seeing the patient lose consci-

¹ *Centrabl. f. Gynäk.*, 1886, vol. x. p. 618.

ousness, the doctor withdrew the tube when less than one-half of the fluid had been used.

The patient recovered at once, and apparently felt well. When the doctor visited her in the evening her condition seemed good, but she had not passed any urine, felt no desire to do so, and the catheter introduced into the bladder brought only a teaspoonful of a grumous, dark fluid.

During the two following days (October 3d and 4th) hardly any urine was secreted, and it remained of a similar quality as before. On the 3d the temperature rose to 101.5° Fahr., and on the 4th to 102.8°. The pulse ranged from 116 to 130, changing at short intervals. On the 4th the patient complained of a sore mouth; the gums were soft and pulpy, the tongue was loaded, the teeth were sore to touch; the mucous membrane of the cheeks showed abrasions, and there was salivation. She had four or five offensive diarrhœic stools. Chlorate of potash was ordered as a gargle and in one-grain doses every hour internally.

On the 5th and 6th the same condition obtained. On the last-named day she was taken out of bed by her friends, and stood upon the floor while the bed was being made. Thereafter the abdomen became swollen, tender, and tympanitic. Morphia was given in one-sixth grain doses twice with two hours' interval, and later every four hours.

I saw her on the 7th. In the morning a little clear urine had been drawn, and later she had passed about one ounce voluntarily. She was drowsy, probably from the effect of the morphine, easily awakened, and intellectually clear. She was assuming a waxy color, with some slight puffiness of the face and extremities; pulse 135, temperature 101.5. I made the diagnosis of acute poisoning with bichloride, and got the impression that the case was hopeless. She took milk and stimulants abundantly, continued the chlorate of potash, and had ice-bags applied to her abdomen.

The next morning (October 8th) the pallor of the entire surface became intense, and extended to the mucous membrane of the buccal cavity. The puffiness and resiliency of the skin were so marked that they produced glossiness of the surface, like that seen in phlegmasia alba dolens. Gradually she lost consciousness, became comatose, and died at 11 A. M. Autopsy not to be obtained.

Even if we will admit the possibility that her peritonitis may have been caused by her getting out of bed on the 6th, this does not materially change the condition. We have the shock and convulsions during the injection, the nearly complete suppression of urine, the bloody, grumous appearance of what little was secreted, and the characteristic stomatitis,—more than enough to warrant the diagnosis even in absence of an autopsy.

The symptoms observed in cases of acute poisoning with corrosive sublimate in obstetric cases are abdominal pain, tenesmus, stinking diarrhœa with or without blood, vomiting, diminished secretion of urine, albuminuria, hyaline casts in the urine, perspiration, erythema, low temperature, frequent, small pulse, restlessness, choking, headache, thirst, somnolence, contracted pupils, redness or a blue color, soreness and swelling of the gums, loosening of the teeth, metallic taste, ulcers or gangrenous sloughing of the mucous membrane of the month, ulceration of the vagina and rectum, collapse and death.

The chief changes revealed by the autopsy are seated in the intestines, the kidneys, and the brain. The large intestine is the seat of extensive ulceration; the cortical substance of the kidneys is swollen, and the tubules contain masses of oxalate of lime. If these are found, they are pathognomonic of poisoning with corrosive sublimate, but they may be absent.¹ The brain is unusually dry.

As to the treatment of acute poisoning by bichloride of mercury, the first indication is, of course, the discontinuation of the use of the drug and the substitution of another antiseptic, such as carbolic acid, acetic acid, or creolin. Diarrhœa and pain are combated by opiates, partially by the mouth, where the local effect at the same time counteracts salivation, and especially enemas of corn starch, a teaspoonful to half a pint of water, with laudanum, twenty-five drops or more, repeated three times a day. Vomiting may necessitate the hypodermic administration of morphine, and is furthermore treated with bismuth, hydrocyanic acid, strychnia, creasote, carbolic acid, hot black coffee, and counter-irritation of the pit of the stomach. The prostration calls for strong stimulants. The choking might perhaps be benefited by nitrite of amyl. If the urine is scant, diuretics ought to be given. I have seen the headache promptly yield to antipyrine in acute mercurial poisoning. The stomatitis should be treated with a gargle with chlorate of potash (ʒij to ʒviii), or, if there are considerable ulcers, with the application of compresses soaked in the saturated solution (1 : 17).

If we take into consideration how many women have been saved by the preventive use of bichloride who otherwise would have succumbed to puerperal infection, the whole number of deaths reported is so small² that if we had to choose between the bichloride treatment, with all its

¹ Prévost: "Étude expérimentale relative à l'intoxication par le mercure, calcification des reins parallèle à la décalcification des os," in *Revue médicale de la Suisse romande*, 1882, No. 11; *Centralb. f. Gynäk.*, 1884, p. 230; Fr. Dahl, *ibid.*, p. 195; L. Butte, in *Nouvelles archives d'Obstétrique et de Gynécologie*, 1887, p. 181.

² L. Butte (*Nouvelles archives d'Obstétrique et de Gynécologie*, 1887, p. 181) in a special historical research found only 13 cases; F. Engelmann of Kreuznach says he knows of 17 (*Centralbl. f. Gynäk.*, July 7, 1888, vol. xii p. 433). That would still average less than 4 deaths annually since Stadfeldt sounded the note of alarm (*ibid.*, Feb. 16, 1884, vol. viii, p. 101).

daughters, and the return to the state of things before antiseptic midwifery began, no man in his senses could hesitate for a moment. In this case statistics furnish such overwhelming proof as to render all scepticism impossible. Still, we ought not to let our patients run unnecessary risks, and a case of this kind occurring in private practice might place the accoucheur in a very embarrassing position.

Some institutions, such as the lying-in hospitals of Copenhagen and Vienna,¹ have returned to or never given up carbolic acid, by which drug they achieve as good results as others who use the more dangerous corrosive sublimate. Still, I do not think it would be wise for us to follow their example. On account of the intimate connection with Charity Hospital, a large general hospital in which all kinds of diseases are treated, we are more exposed to septic influences than those who work in institutions that are strictly lying-in hospitals and nothing else. We need, therefore, the protection offered by the most powerful antiseptic.

Carbolic acid had been more or less in use in the hospital for years before bichloride was introduced. I myself used it even very systematically. When I was appointed visiting surgeon in 1881, I introduced the following treatment: Before and after each vaginal examination doctors and nurses washed their hands in a 2 per cent. solution. The same was used for vaginal injections, one of which was given immediately before and after delivery and morning and evening during the first eight days after delivery. Instruments were disinfected in a 5 per cent. solution. In those cases where the hand or instruments had been introduced into the uterus this organ was washed out with a quart of a 2 per cent. solution. All the patients had their genitals covered with a compress dipped in 10 per cent. carbolized oil, which was kept in place by a large pad of oakum inserted between the thighs. This treatment was used during six months in about 200 cases. The mortality was 4 per cent., and all the deaths, with the exception of one, were due to septicæmia.

During my second term of service, from October 1, 1882, till April 1, 1883, the vaginal injections and the carbolized compress were discontinued, but carbolic acid was still used for disinfection of the hands and instruments, and the genitals were dusted with a mixture of 1 part of salicylic acid and 4 parts of corn starch. During this period 192 women were delivered, 15 of whom died—a mortality of 7.8 per cent. The morbidity was so great that 1 out of every 4 puerperæ was seriously ill. I remember that the solution furnished us from the drug-store of Charity Hospital was sometimes badly mixed or the drug of inferior quality. So much is sure, that it sometimes scalded the patients and gave rise to smarting wounds, which, by lowering the

¹ Stadfeldt, *loc. cit.*; Ehrendorfer: *Archiv für Gynäk.*, 1886, vol. xxvii. p. 193.

vitality of the patient, may have contributed to the high mortality. The smell of carbolic acid sticks to your hands, and is to most people quite disagreeable, especially when mixed with that of the lochia. Many, including myself, feel their skin, their nerves, nay, their whole constitution, unpleasantly affected by the use of this drug. It is even poisonous. I do not know, however, if it has caused death directly when used in midwifery, but Mänrer came very near losing a patient in this way,¹ and Veit² has made similar observations. For all these reasons I do not feel inclined to return to carbolic acid.

How much more effective bichloride of mercury is than carbolic acid, both to ward off disease and to diminish its severity, appears also from a recent report from Innsbruck in Austria. Of 2183 parturient women, 768 were treated with carbolic acid, 1415 with corrosive sublimate. Of the former, 155, or 20.1 per cent., were taken sick, and 117, or 15.1 per cent., of them suffered from puerperal diseases. Of the latter only 98, or 6.9 per cent., were sick, and only 44, or 3.1 per cent., suffered from puerperal diseases. Of those treated with carbolic acid, only 43 of 117, or 36.7 per cent., recovered in less than twenty days, whereas of those treated with corrosive sublimate more than one-half were well within the same space of time.³

All that has been said against bichloride of mercury applies, of course, to the biniodide, which is still more poisonous, indissoluble in water, and more expensive.

Potassium permanganate has been praised in puerperal fever by Chadwick, Sinclair, and Goodell.⁴ I have had no personal experience with it, and do not know if it would answer all purposes. What we must try to find is a substance that is a reliable germicide, but not poisonous to the human organism; that does not irritate wounds nor corrode instruments; that is easily dissolved in water; capable of mixing with oleaginous substances; a deodorizer, but without smell itself; and easily obtainable at a low price.

Some years ago Dr. George P. Fowler⁵ of Brooklyn, N. Y., made a strong plea for hydronaphthol, and his observations were confirmed by Dr. R. J. Levis of Philadelphia.⁶ It is said to rank next after corrosive sublimate as an antiseptic. It is, however, a proprietary drug, and cannot be prescribed in our public charitable institutions.

Dr. F. Engelmann of Krenznach recommends acetic acid in 3 and 5 per cent. solutions,⁷ but he has only had very limited experience with it

¹ Mänrer: *Centrablatt für Gyn.*, 1884, vol. viii. p. 487.

² Veit: *Berliner klinische Wochenschrift*, 1879, No. 3.

³ Torggler: *Allgemeine Wiener med. Zeitg.*, 1888, Nos. 26 and 27; *Centralbl. f. Gynäk.*, Nov. 17, 1888, vol. xii. p. 760.

⁴ *Trans. Amer. Gynecol. Soc.*, 1879, vol. iv. pp. 119, 123, 133.

⁵ Fowler: *New York Medical Journal*, 1885, vol. xlii. p. 374 *et seq.*

⁶ *Ibid.*, p. 593.

⁷ *Centralblatt f. Gynäk.*, 1888, vol. xii. p. 433.

himself, and I have had none. It is very cheap, but the odor is rather disagreeable, and I would expect it to smart and irritate wounds.

I am now trying creolin. This is a black, thick fluid, much like coal-tar in appearance and odor. It does not dissolve in water, but forms, when added to it up to 12 per cent., a nearly homogeneous emulsion. The weaker solutions are almost milk-colored; the stronger look like coffee mixed with much milk. It was first brought on the market by a manufacturer named Pearson in Hamburg, Germany. When it is mixed with hot water it leaves, even when well stirred, small black specks which sink to the bottom of the vessel. In order to obtain a good emulsion it should first be mixed with cold water, to which later hot water may be added without causing any precipitation. The creolin should be added to the water, not water poured on creolin, as by the first process a better mixture is obtained. A small amount of creolin dropped into water forms a milky cloud. Experiments with different microbes have proved it to possess very high antiseptic power. It ranks as second only to bichloride of mercury, and is much more efficacious than carbolic acid. Eisenberg¹ found that a 3 per cent. solution kills all germs in one minute, and a 5 per cent. solution kills all in ten seconds, the shortest time in which it is possible to make the experiment. It has great hemostatic power, and does not irritate wounds when used in emulsions of $\frac{1}{2}$ to 2 per cent. It is not convenient to have instruments lying in it during operations, since they cannot be seen, and become somewhat slippery. On the other hand, this quality of making slippery is, in my opinion, one of its great claims in obstetric practice. I was most agreeably surprised in a case of turning to feel my hand slip through the vagina and cervix with a hitherto unknown facility after a vaginal douche of 2 per cent. had been given. In this respect its effect is just opposite to that of bichloride of mercury, which has a strong astringent power. As its chief advantage it has been claimed that it should be entirely innocuous to man. This dogma was especially founded on the fact that one dog was made to swallow 30 grammes (5viiss), and another 50 grammes (5xiiss), without any bad effect. Still, a case has already been reported in which it is supposed to have caused death: "After delivery a uterine douche of about two quarts of a 2 per cent. creolin solution was given to a healthy primipara of twenty-seven. On the following day a douche of a quart of 1 per cent. creolin solution was given, and on the next day a douche morning and evening, the last at half-past six. At nine o'clock she suddenly became pale, cold, and vomited: the vomiting did not cease; perspiration supervened, and the patient died at eleven o'clock in collapse and unconscious, with a temperature of 96.7° Fahr. The vomitus had a strong odor of creolin, and also the urine found in the blad-

¹ Eisenberg: *Wiener med. Wochenschrift*, 1888, p. 564.

der after death. Five hours before her death the patient was well and strong."¹

It would be a sad disappointment if this case should be followed by similar ones, showing that death in it was not due to an idiosyncrasy of the patient.

During the last six weeks I have used a 2 per cent. solution in the Maternity Hospital, instead of bichloride of mercury, for all vaginal and intra-uterine douches. Intra-uterine injections of one to two quarts have been used on 21 patients for post-partum hemorrhage, after removal of retained membranes, turning, expulsion of meconium into the uterine cavity, or the delivery of a macerated fœtus. Vaginal douches have been used after labor on 17 patients on account of the performance of the low-forceps operation or perineorrhaphy. Vaginal douches, as preparatory treatment before labor, have been used in 47 cases.

So far, I am well pleased with creolin. The smell is by far not so disagreeable and tenacious as that of carbolic acid. It is pleasant to the touch, and does not affect either skin or nerves. Some patients have, however, complained that it smarted. I used it in one case of puerperal diphtheria, but cannot recommend it under those circumstances, because the grayish color of the fluid prevents one from judging of the condition of the inside of the womb by seeing secretions or shreds. I substituted carbolic acid, which shares with creolin the fault of covering by its own odor that of the secretions, but allows one to see what is washed out from the uterus.

Until we find a safe and reliable antiseptic that can replace corrosive sublimate, I think the best we can do is to continue to use it for the disinfection of ourselves, of the outer parts of the patient, and of substances that come in contact with her, and to substitute creolin or carbolic acid for vaginal and intra-uterine injections.

Antiseptic Conduct of Labor.—In another part of this work are found rules for what briefly may be designated as the obstetric part of the conduct of labor,² by which term I wish to designate all that the accoucheur was taught to attend to before the era of antiseptic midwifery began. Here we have only to give the necessary supplement consisting of a plan how to do all that in an aseptic and antiseptic way. We have just seen (p. 334 *et seq.*) how doctors and nurses disinfect themselves, and how instruments and other objects coming in contact with the patient are disinfected. We will now examine what other points have to be considered.

Even with the best antiseptic solutions and with all possible care it must be borne in mind that every time a vaginal examination is

¹ *Therapeutische Monatshefte*, October, 1888; *Am. Journ. Med. Sci.*, Feb., 1889, p. 172.

² Vol. I, pp. 493-513.

made we expose the patient to the danger of infection by germs either adhering to the examining finger, or floating in the air, or concealed in some fold of the vagina where they may have escaped destruction by the preliminary douche. It is therefore desirable that these examinations be made as seldom as possible. As our training-school is only destined for nurses, and does by no means aim at the production of midwives, we do not allow the nurses to make any vaginal examinations, except the one who has charge of the waiting ward, and whose duty it is to notify the house staff of beginning labor, and the head-nurse in the pavilion in which the delivery-room is situated. Even these two nurses and the doctors are ordered not to repeat the examinations oftener than necessary for their guidance in performing their respective duties.

Another point of still greater importance is not to introduce the examining finger more deeply than necessary. All that is needed in ordinary cases is to examine the presentation and the degree of dilatation of the external os.¹ This ought to be done without entering the womb at all. It may be gratifying for the ambitious young doctor to make out the position too at an early stage, but he ought to abstain from such an investigation if it involve a deeper examination than can be made without going beyond the os. By combining abdominal palpation with the vaginal examination he will obtain further information, and by waiting until labor progresses farther he will in course of time be able to recognize all facts necessary for the proper conduct of the case, without exposing his patient to an unnecessary danger.

Lubricants, such as soap, oil, fat, glycerin, etc., are unnecessary and dangerous. Even 10 per cent. carbolized oil has hardly any antiseptic value. The fluid that adheres to the finger when we dip the hand into the solution of bichloride the last moment before entering the vagina is all that is needed. The same applies to the forceps and other instruments in regard to carbolized water. The only purpose for which I find a lubricant necessary is the introduction of the whole hand into the vagina or womb. Then I use glycerin with 3 per cent. carbolic acid, or, still better, mollin with 5 per cent. Mollin looks much like lard; it softens while being rubbed on the skin, makes the latter more slippery than any substance I know of, and comes off much more easily than lard by washing in water.

In protracted cases the vaginal injections are repeated about every three hours. The more frequently examinations are made, the oftener these injections become necessary; but as these affect the epithelium, which may even be cast off, they ought to be used as rarely as possible.

¹ The pelvis is examined and measured at the time of admission, which mostly takes place long before labor sets in.

When the presenting part appears at the vulva a piece of lint wrung out of bichloride (1 : 2000) is applied to the latter. It serves partly to prevent a too free access of air to the genital tract when the fœtus moves to and fro, advancing and receding with the contractions of the uterus and their intermissions; and partly it makes all manipulations for the protection of the perineum, such as pushing the head back into the genital canal or pressing the occiput against the pubic arch, much easier by taking away the slipperiness of the presenting part.

Removal of the After-birth.—After the child is born not even a finger ought to be introduced into the vagina in normal cases. During the passage of the child the genital tract is enormously distended, and sustains numerous abrasions and tears, all of which are wide-opened doors for the admission of septic germs. In my opinion, it is of little importance, and not even desirable, to remove the after-birth within a few minutes after the delivery of the child, as taught by Credé.¹ Such an early removal leads to retention of the membranes and post-partum hemorrhage. I seldom remove the placenta in less than fifteen minutes after the birth of the child. In my estimation, the chief merit of Credé's method is the point that the placenta is expelled by pressure from above, and that neither cord nor placenta is touched inside of the body of the woman. I use always both hands for the expression, placing the eight fingers as far down behind the uterus as possible, and the two thumbs in front. The chief movement is one of squeezing, the thumbs and fingers being pressed against one another; but this is combined with another movement, by which the uterus is pushed in the direction of the hollow of the sacrum.² With very few exceptions the placenta will roll out of the vulva and sink down on the couch between the thighs. Sometimes the whole ovum comes out in this way, but in most cases it is necessary to help the membranes out, which act ought to be done with the greatest deliberation and gentleness. As I have convinced myself in three Cæsarean sections, the thin elastic membranes adhere to the inner side of the uterus when it contracts and throws off the thick placenta, and have to be peeled off cautiously. This is best done by turning the placenta slowly, so as to form a rope of the membranes, which is seized between the index and

¹ The average time in 2000 deliveries was four and a half minutes (Credé in *Archiv für Gynäkologie*, 1881, vol. xvii. p. 279).

² In a special paper on this subject, published in the *American Journal of Obstetrics*, vol. xvii. No. 5, 1884, I have shown how unjust it is when some of Credé's own countrymen have impugned his originality and pretended that his method was the same as the so-called Dublin method. The most authorized interpreters of that school speak of putting the cord on the stretch, hooking the fingers into rugosities formed by the umbilical vessels, and drawing on the funis—things which are all against the spirit of antiseptic midwifery.

middle fingers placed transversely in front of the vulva, and extracted very carefully, alternating with the fingers of both hands. If, on inspection, we find that any part of the placenta has been torn off and remained in the uterus, the well-disinfected hand must be introduced into the womb, the inside scraped with the finger-nails, and all remnants of the ovum removed; after which the uterus is washed out with antiseptic fluid. The danger of infection from any part of the placenta left behind is so great that that of removing it, provided it be done with full antiseptic precautions, is comparatively very small.

If part of the membranes are retained, opinions differ. Some good authorities leave them to be expelled with the lochial discharge, but, having seen both post-partum hemorrhage and septicæmia follow when they were allowed to remain in the uterus, and, on the other hand, never having had any trouble from the introduction of the hand into the uterus, I invariably search this organ for shreds when parts of the membranes have been torn off. In judging if this has happened or not, their great elasticity must be borne in mind, in consequence of which they appear much smaller than they must have been when they contained the child and the liquor amnii.

Intra-uterine Injections are used in every case in which it has been necessary to introduce the finger, the hand, or instruments into the interior of the womb, and in cases of stillbirth when the child is macerated and the liquor amnii looks or smells badly. In order to avoid the possibility of the fluid going by gravitation through a dilated tube into the peritoneal cavity, the patient should lie on her back. A bed-pan is pushed in under her buttocks. A glass tube twelve inches long, curved like a male catheter, with an opening at the end and several others on the sides near the end, is connected with the tubing of the fountain syringe and introduced into the uterus between the middle and index fingers of the left hand held in the cervical canal. Before entering the uterus the vagina should be washed out and the flow kept up during the introduction of the tube into the womb. Sometimes a little resistance is met with, and then the accoucheur should draw the tube back and try in another direction. By failing to do so one of my assistants perforated the posterior wall of the cervix. The tube entered the peritoneal cavity just above the junction between the cervix and the body of the uterus. The usual injection of a quart of bichloride (1 : 4000) was given, the patient collapsed, and died in six hours. The autopsy showed beginning peritonitis.

Before introducing the tube the obstetrician should measure how far it has to go in in order to reach the fundus; he should ascertain that it goes in the direction of this part; he should feel the resistance with which it meets in touching the fundus; and he will often even be able

to feel the point of the tube through the abdominal wall. By paying attention to all these details such a deplorable accident would have been avoided.

For years we have been using for the intra-uterine injections a 1:4000 solution of bichloride of mercury, but, as stated above, I think it is safer to take creolin (2 per cent.) or carbolic acid (2 per cent.). The amount need rarely exceed one quart. The fountain jar should not be held more than a foot above the fundus uteri. The fluid should be so hot that the hand can just be kept in it (110° – 115° Fahr.). This causes considerable pain, but is necessary in cases of post-partum hemorrhage, and immediately after delivery it is wise to use such hot water, even if there is no hemorrhage, in order to prevent it. The hot water is a powerful stimulant for the uterus which nearly always insures contraction. I have never seen thrombi torn off by introducing the tube up to the fundus, and only to introduce it as far as the internal os, as advised by some, does not insure a thorough disinfection of the whole cavity. The cervix is so large that the water easily finds an outlet. Catheters with double current are therefore not necessary. Most of them are hard to keep clean, and sometimes the water may flow from the narrow afferent tube to the wide efferent tube without filling the cavity in which the catheter is held; not to speak of the danger if by mistake connection is made between the wide tube and the fountain syringe. In this way one of my assistants ruptured a uterus that was already thinned by the loss of substance caused by dissecting metritis.

After the injection the fluid should be squeezed out from the uterus and removed from the vagina by turning the patient on her side.

Dressing.—After the removal of the after-birth the patient is again washed with bichloride (1:2000). For the vulva I prefer pledgets of absorbent cotton; for the skin clean muslin rags are more convenient. I take care to remove the clotted blood with which the pubes are matted together. If the hairs be long and fine, this procedure is shortened considerably by cutting part of them off, together with the adherent blood. As there frequently comes a little gush of blood some time after the removal of the placenta, and it is annoying both for patient and doctor to do the work over again, I think it is good policy not to begin the cleaning too soon. In the Maternity Hospital it is even the rule to compress the uterus with the hand for half an hour before the binder is put on.

To the latter is fastened an antiseptic occlusion bandage (Fig. 100, 3), consisting of (1) a piece of lint, twelve by eight inches, folded twice lengthwise, so as to be three inches wide, the average distance from one genito-femoral sulcus to the other; (2) a piece of oiled muslin, four

inches wide and nine long; (3) a large pad of cotton batting; and (4) a piece of muslin, half a yard square. The lint is wrung out of the solution of bichloride (1 : 2000) and carefully applied over the vulva and the anus. The oiled muslin is washed with the same solution and placed over the lint, turning the edges forward against the inside of the thighs. These two constitute the antiseptic part of the dressing. The pad of cotton outside serves only to keep the compress in apposition to the entrance of the genital canal, and is itself held by the muslin kerchief, which is folded like a cravat and fastened to the binder with four pins in front and two behind. A good binder should go down beyond the trochanters, and a A-shaped opening left at the genitals, which is closed by the pad just described, as seen in the figure. This dressing is changed every six hours, or oftener if the patient has a movement or passes her urine in the mean time. Before the fresh dressing is applied the genitals and nearest parts are irrigated with bichloride (1 : 2000), the patient lying on a bed-pan. No injection is given; nay, the genitals are not touched.

Some think this way of dressing the genitals after delivery is superfluous; and it must be admitted that excellent results are obtained without it. Still, much may be said in favor of it. In the first place, people are accustomed to cover the genitals in some way with napkins, rags, or compresses, but anything not specially prepared, so as to be aseptic, that is brought in contact with the genitals of a puerpera constitutes a positive danger of infection. If the antiseptic pad is not used, it is much better to desist from any kind of cover. Secondly, I think this occlusion bandage is entirely rational. We have to do with wounded tissues, and we cover them with an antiseptic dressing, just as we do a wound caused by an operation or by injury. Under all other circumstances the "open" wound treatment has been superseded by the occlusion dressing and by the antiseptic dressing. Why should we not give the parturient canal the same advantages? As I believe that puerperal fever may be acquired by germs floating in the air and entering the genital canal, it is a precaution to close its entrance. By my pads air is virtually kept out or so filtered that it becomes sterilized. Even to those who do not admit infection through the air the pad ought to recommend itself by keeping out of the way those "solid bits of dirt" to which Mr. Lister has called attention as constituting the chief danger to wounds. Soft and warm, it is very pleasant to the patient. It keeps the air in the wards entirely free from odor. It has a favorable influence on both patient and nurse. The former, especially if she has gone through a confinement before, or if she hears from friends that nobody took so much trouble with them when they were confined, feels that she is being taken particularly good care of; the latter is reminded of the great truth that the rima pudendi is the chief

entrance for agents that may jeopardize the life of her patient and cause herself considerable trouble.

The pad does not favor the retention of lochia and the formation of clots in the genital canal. Quite the contrary: its inner layers being formed of a highly porous substance, a continuous suction is going on through its thousands of capillaries, and the result is that the formation of a clot is a very rare occurrence; in fact, much more so than if the genitals are left unprotected or only covered with a napkin.

The bichloride imparts a whitish color to the skin and a bright-red color to blood. Wounds become often covered with a thin, sulphur-colored layer of inspissated pus, which the beginner must be careful not to confound with the patches found in puerperal diphtheria. In exceptional cases the pad causes a little smarting or even a slight eczema, easily remedied by painting the part with glycerin before applying the pad.

Ergot.—As a good contraction of the uterus is a great protection against puerperal infection, the use of ergot deserves to be mentioned in this connection. Having seen how difficult it may be after the administration of this drug to enter through the internal os if such a manipulation becomes necessary in order to remove the whole or parts of the after-birth or arrest hemorrhage, I never use it before the uterus is entirely empty, but then I give a teaspoonful of the fluid extract. If there is a rather free flow, I give half a fluidrachm every three hours, and in all cases I give this amount three times a day, as a rule, until an ounce has been used in all.

Perineorrhaphy.—Every primipara sustains a tear at the posterior part of the entrance to the vagina,¹ the circular opening forming the limit between the vulva and the vagina, while the skin between the anus and the vulva forming part of the boundary of a much larger opening escapes in many cases. The internal wounds are, as a rule, not treated. At one time I tried it, but found that it gave rise to retention of lochia and wound-infection. That was, however, before the introduction of strict antiseptics. If the tear extends from the entrance of the vagina to that of the vulva, the rima pudendi, the commonly so-called laceration of the perineum, preventive antiseptic treatment, apart from gynecological considerations, demands an immediate repair. A tampon of cotton wrung out of a solution of creolin or carbolic acid (2 per cent.), to which a string is attached, is introduced into the vagina above the upper limit of the tear. Thus the bloody discharge from above is kept away from the wound while it is being sutured. Shreds that hang only by a pedicle are cut off, the wound is irrigated with one of the named solutions, the sutures, either silver or

¹ J. Mathews Duncan: *Papers on the Female Perineum*, London, 1879, p. 8.
VOL. II.—23

aseptic catgut or silk, are inserted, the surface is again irrigated, dusted with iodoform, and the sutures closed.

Catheterization.—The old way of drawing the urine under the bed-clothes was modest, but is irreconcilable with antiseptic midwifery. By carrying mucus from the vulva into the bladder we are apt to cause cystitis. The parts must be exposed, and the surroundings of the meatus carefully wiped with absorbent cotton wrung out of bichloride or another disinfectant solution, before introducing the catheter. In hospitals only metal catheters ought to be used, as elastic and soft-rubber catheters are more or less absorbent and cannot be kept sufficiently aseptic. If the expense of silver catheters is objectionable, those of nickel-plated metal, costing fifty cents, are quite as good. They ought to be kept in glass jars filled with carbolized water (5 per cent.), but as this is much too strong for the urethra, they ought to be rinsed with plain lukewarm water immediately before using them.

Syringes.—In preantiseptic times the nozzles of syringes were doubtless often the carriers of poison from patient to patient and the true cause of so-called epidemics. This is easily avoided by having fountain syringes and a sufficient number of glass nozzles—one for the rectum and another for the vagina—so that the same tube is only used for one patient during her lying-in period. When she leaves the tubes may be destroyed or disinfected by boiling them in a solution of bichloride 1 : 1000. If they have been used in a patient suffering from puerperal infection, the tubes ought always to be destroyed.

Cost of the Antiseptic Treatment.—Even regarded from the standpoint of economy, the antiseptic treatment recommends itself. Before its introduction we used enormous amounts of quinine and whiskey. Now our consumption of these expensive drugs has become so insignificant that the hospital, in spite of the new expenses caused by the antiseptic treatment, is run at much smaller expense than formerly.¹ The four dressings for each patient in the Maternity Hospital cost about ten cents a day, which averages about one dollar for the whole lying-in period. The corrosive sublimate costs only sixty-five cents per pound, creolin sixty cents, and carbolic acid in crystals fifty cents.

II. PREVENTION OF PUERPERAL INFECTION IN PRIVATE PRACTICE.

While the principles of antiseptic midwifery are now followed in the lying-in hospitals of all civilized countries, and while in those countries in which private confinements are mostly in the hands of midwives, such

¹ Oiled muslin may be bought of W. B. Lawrence, 96 Spring St., for \$1.65 per roll, each roll containing five yards and being one yard wide; absorbent lint of Seabury & Johnson, 21 Platt St., for 52 cents per pound, a pound package measuring seven and one-third yards in length and eighteen inches in width; and absorbent cotton of the same firm, for 48 to 52 cents a pound, according to the quantity taken at a time.

as Germany and Denmark, the latter are bound by governmental regulations to conduct the labors they take care of antiseptically, antiseptic prophylaxis in private midwifery practice is yet in its infancy in this country. I am convinced that among the numerous midwives practising in New York it is hardly employed at all, and that even among doctors only a minority use it in midwifery practice.

I wish it were possible to find statistics showing the mortality of childbed in New York City outside of the hospitals; but in the way deaths and births are now registered they would be of little value and could only be obtained at great expense. We must therefore try by other methods to get an idea of what the mortality of childbirth and childbed in private practice may be.

The following list¹ shows the results obtained by some prominent obstetricians in Great Britain and Ireland:

	Deliveries.	Deaths.
M. Duncan	736	7 = 1 in 105.
McClintock	652	6 = 1 in 108.
J. Clarke	3,847	22 = 1 in 175.
Crosse	1,377	14 = 1 in 98.
Labatt	4,368	26 = 1 in 168.
"A London accoucheur" .	2,982	30 = 1 in 99.
Brunker	334	6 = 1 in 56.
Churchill	2,548	16 = 1 in 159.
"A physician"	10,190	107 = 1 in 95.
T. E. Beatty	2,064	19 = 1 in 121.
Total,	29,098	251 = 1 in 116, or 0.86 per cent.

All these patients were from the upper or middle ranks of society. If among this favored class and in the practice of the most skilful obstetricians the mortality due to childbirth amounts to 1 in 116, we can imagine how much greater it is when the figures comprise on one hand all general practitioners and ignorant midwives of a large city, and on the other the whole population, down to the poorest and most abject woman giving birth to a child on a dirty bed in a crowded tenement-house.

But we need not draw alone on our imagination. We can come very near the actual number of deaths in another city. In Copenhagen, the capital of Denmark, 108,737 women were delivered during the twenty-five years from 1850-74. Of these, 885 died of "puerperal fever"—*i. e.* 1 in 123—and while the number of confinements is entirely reliable, that representing the deaths is too small. The term "puerperal fever" was then—and is in some degree now—used in a very restricted sense. There is no doubt that many deaths that properly were

¹ Mathews Duncan : *Mortality of Childbed and Maternity Hospitals*, Edinburgh, 1871, pp. 22, 23.

due to puerperal fever were registered under other headings, such as peritonitis, metritis, hepatitis, nephritis, phlebitis, etc. The ratio 1 : 123 is consequently too small, even if we speak of puerperal fever alone ; and if we add the mortality in childbirth and childbed from other causes than puerperal fever, the proportion of deaths to confinements will be a much larger one. Since the beginning of the year 1873 all deaths connected with parturition and the puerperal state are registered under two headings, one of puerperal fever, and one of all other causes except puerperal fever :

Year.	Deaths from Puerperal Fever.	Deaths in Childbirth and Childbed excepting Puerperal Fever. ¹
1873	45	17
1874	38	21
1875	44	17
1877	42	13
1878	58	8
1879	31	20
1880	31	18
1881	43	12
Total	332	126

These data are for the whole city, inclusive of the lying-in hospital. If we now take these figures as a basis, and suppose that the deaths caused by childbirth and the puerperal state, exclusive of puerperal fever, be proportionally divided between the lying-in hospital and the rest of the city, we would have to add 336 to the above 885 deaths, which makes 1221, and this divided into 108,737, the total number of deliveries, is 89. 1 in 89, or 1.12 per cent., would then be the mortality of childbirth and childbed in private practice in a large city.²

By computation we can find that it is, to say the least, not much less in the city of New York. Lusk³ found the number of deaths from diseases complicating pregnancy, from the accidents of childbirth, or from diseases of the puerperal state in this city, from 1867 to 1875, to be 3342. The number of births being unknown, it is estimated to be 284,210.⁴ From the 3342 deaths have to be deducted 420 that occurred in hospitals, which leaves 2922 for the city. This, divided into the number of confinements, would be equal to 1 in 97 ; but this

¹ Official reports published in *Ugeskrift for Læger*. I have no means of consulting the later volumes of this journal.

² Copenhagen has now about 300,000 inhabitants, but at the period referred to the population ranged from 150,000 to 200,000.

³ W. T. Lusk : "On the Nature, Origin, and Prevention of Puerperal Fever," *Trans. of the International Medical Congress*, Philadelphia, 1876, reprint, p. 3.

⁴ This number is arrived at in the following way: The census of the year 1870 gives to New York a population of 942,292. The average increase from 1860 to 1870 was 15,000. The same increase is supposed to have taken place during the following five years. The births are estimated to be 33 in 1000—an estimate which errs on the side of liberality.

mortality is evidently too low, since we ought to deduct all the confinements that took place in hospitals. This I have no means of finding, but I will at least collect the figures, as far as they have been accessible,¹ of women who were confined in hospitals during any part of the nine years examined by Lusk :

Lying-in Asylum, 85 Marion St.	1867-75	719 deliveries.
Infant Asylum	1872-75	317 "
Infirmary for Women and Children	1867-75	703 "
Nursery and Child's Hospital	1867-75	1333 "
Charity Hospital	1874-75	896 "
Emigrant Hospital	1868-75	3189 "
Bellevue	1873-74 (1st half)	615 "
Total,		7772

To these 7772 ought to be added the number of births that occurred in Bellevue from 1867 to 1872 and in the Emigrant Hospital during 1867; but as the records are not to be found, we must satisfy ourselves with an estimate; and, according to the above figures, we do not risk to err much by supposing that there were on an average at least 400 women a year confined in each place. This would give 2800 additional births to be deducted from the city's account.

Thus, from the number of 284,000 births we have to deduct 10,572 which took place in hospitals. We find, then, that to the charge of the city of New York outside the hospitals should be assigned 273,428 births, with 2922 deaths, or 1 in 94, or 1.06 per cent.

If these figures, 1 in 89 or 1 in 94, are not absolutely exact, and are only found by computation, they are computed in a way that makes the mortality in the city rather appear too small than too large. So much is sure: that out of every 100 women who give birth to a child in a private house in New York, 1 dies during or shortly after labor.

The same applies to the Maternity Hospital, but when we take into consideration that nearly one-half of our patients are primiparæ, that they all are poor, that many of them are ruined by drink and debauchery, and that the hospital by its intimate connection with a general hospital presents peculiar dangers which cannot be entirely overcome, private practice, with its large proportion of wealthy, pure, and healthy parturient women, and its great preponderance of multiparæ, ought to obtain better results than the hospital.

I have no doubt that this will be so when our physicians generally adopt antiseptic midwifery. An old physician with a large practice has told me that he used to have a case of puerperal infection every month, but during the last five years, since he adopted the treatment

¹ Garrigues: "On Lying-in Institutions, especially those of New York," *Trans. Am. Gyn. Soc.*, vol. ii., 1878, p. 646.

described by me,¹ he has been entirely free. I wish these lines may engage many to follow his example.

Honorable physicians object to the use of antiseptics in midwifery cases in private practice because they deem them superfluous. They say that they have kept record of their cases since they started as practitioners, have had five or six hundred confinements, and have never lost a patient. To this I can only answer that the number is yet too small to draw a general conclusion from it, that general statistics show that to such a number of confinements correspond half a dozen deaths, and that they may expect their turn of trouble. Besides, mortality is not the only thing to be taken into consideration. The question is, How many of these patients have been more or less sick during their lying-in period? Perhaps much pain, anxiety, and expense might have been avoided by following the prophylaxis recommended in these pages.

Others say that they are busy practitioners, that the preparation of antiseptics takes time, and that they have to be satisfied with so low a fee for their obstetric work that they cannot afford to spend so much time on it. This point is well taken, but I believe that in the long run these physicians will find it to their advantage to adopt at least part of the antiseptic preventions. If they fail to do so, they cannot avoid getting septic cases. These take much time to treat; the result is very doubtful; and the patient and her friends are very likely to throw the blame for the undesirable occurrence on the physician; which may hurt his interests. He risks to carry infection from this case to others. He may even be obliged to give up midwifery practice for a time, and thus his loss will be much greater than if he devoted a quarter of an hour to disinfection.

Others, again, say their patients do not want to be bothered with all these precautions against a danger which they do not see and the scope of which they do not realize. Nor do they care to go to the extra expense entailed by buying the necessary materials for the antiseptic treatment. They have no trained nurses, but have to be satisfied with the services of a relative, friend, or untrained hired person. We will presently see that the antiseptic treatment may be so simplified that any person with average intelligence can carry it out, that it costs very little or nothing, and that it gives so great comfort to the patient that, even apart from all considerations of safety, she is amply rewarded for the small inconvenience of being disinfected.

Country practitioners are still more averse to antiseptic prophylaxis than their confrères in the cities. They insist, with good reason, on the purity of country air and the robust constitutions of their patients; but if these circumstances give them better chances of recovery when

¹ *Medical Record*, Dec. 29, 1883.

sick, they cannot prevent them from being infected. In some respects the dangers for the parturient woman are even greater in the country than in the city. Everybody who has paid attention to it knows how difficult it is to dispose of all refuse, dirt, and excremental substances in the country. Manure, that is a mixture of feces and rotting vegetable substances, is spread over the fields. A butcher kills his animal, lets the blood soak into the ground, and hangs the skin up to dry on a hedge, where it can be smelt at a long distance. The peculiarities inherent to country practice expose the patient more to infection by her accoucheur than in the city. The long distances prevent him from going home and changing his clothes when he has seen a case of puerperal fever or any other disease that may give rise to it, or performed an autopsy. He has to take the cases in the order they come, and the same fingers that a little while ago were bathed in the foul pus of a perineal abscess, performed tracheotomy for diphtheritic croup, or dressed a patient with erysipelas have now to be introduced up to the fundus of the uterus and peel off an adherent placenta.

The mortality from puerperal causes may even be very high in country practice, as shown in the following instance: Sprachbrücken, a little village near Darmstadt in Germany, had during five consecutive years the following puerperal mortality, viz.: in 1860, 18 women were confined, 1 of whom died; in 1861 there were 26 confinements, with 4 deaths; in 1862, 29 confinements, again 4 deaths; in 1863, 24 deliveries, with 3 deaths; in 1864, 25 deliveries, with 1 death—or, in all, 122 women confined, 13 of whom succumbed—a mortality of 10.6 per cent.,¹ which is much worse than it ever was in the Maternity Hospital.

There is, therefore, just as much, if not more, call for antiseptic prevention in midwifery in country practice as in city practice.

In wealthy private practice I carry out the treatment as described above for the hospital, with very few modifications. Where several rooms are at our disposal we ought to choose a large, airy, light, and preferably sunny one. It ought to be as far away from the water-closet as possible. If it is adjoining to the bathroom, the door ought to be kept closed, and some of Platt's chlorides or another powerful disinfectant should frequently be poured into the water-closet. Even a washstand with running water, and consequent connection with the sewer, is not without danger.

Instead of lint I use for covering the genitals a pad of absorbent cotton, finger thick and otherwise of the proportions stated above.²

¹ Hegar: *Die Sterblichkeit während Schwangerschaft, Geburt. und Wochenbett*, Freiburg im Breisgau, 1868, p. 42.

² The so-called sanitas pads used during menstruation by many ladies, and sold for fifty cents a dozen by Mrs. Fletcher, 6 E. Fourteenth street, are very convenient for this purpose.

Instead of oiled muslin I take thick gutta-percha tissue. It is better than oiled silk, and costs just one-third. The dressing is only changed three times a day, morning, afternoon, and evening.

There ought always to be a plentiful supply of the standard solution of bichloride of mercury (1 : 1000), creolin, and carbolic acid, hot and cold water, on hand, so that the accoucheur at any moment can have solutions of different strengths and different temperatures.

He ought likewise to order the patient beforehand to have the necessary vessels in readiness—viz.: two glass quart bottles with corks, two pitchers, and two basins, all of china or a similar non-metallic substance. He had better clean all these utensils himself before using them. The bottles contain the standard solution; the pitchers are for hot and cold water; and the basins for dilute solution of bichloride, creolin, or carbolic acid. One powder of fifteen grains of bichloride or two tablets of seven and six-tenths of one grain, as they are on the market, dissolved in a quart of water, form the strong solution of 1 : 1000. Bichloride is easily dissolved in hot water, and still more so in alcohol, one of which ought to be used before cold water is added. Carbolic acid mixes likewise more easily with hot water than with cold; the mixture ought to be stirred until every trace of the oily drops has disappeared by being dissolved in the water. Creolin mixes very easily with water, forming a milky emulsion.

Where economy is necessary this treatment may be much simplified. For the pad common cotton batting may be used instead of absorbent cotton, and then the gutta-percha tissue may be dispensed with. Nay, we may even give up the occlusion dressing altogether. Thus, in its most reduced shape the preventive antiseptic treatment consists only in the disinfection of the patient, the accoucheur, and his instruments, and many physicians carry corrosive sublimate, in substance or alcoholic solution, and carbolic acid, in their satchels, so that the patient does not incur any extra expense whatsoever by the antiseptic treatment; and they might add an ounce of creolin. But whenever possible I would recommend to let a solution of bichloride run over the surroundings of the genitals three times a day. A bed-pan may be replaced by a flat tin basin, which only costs a trifle.

For vaginal injections the nozzle of hard rubber or even metal which accompanies most syringes will do. Intra-uterine injections may be given through so-called "soft-metal" catheters, that are cheap and present the advantage over glass of being flexible, which allows their being used in abortion cases. A new English catheter, about No. 10 or 11, is likewise good, provided it never be used in another case. The uterine sound used as a stylet facilitates its introduction very much.

Reduced to its lowest degree of simplicity, the antiseptic treatment is really so simple that it can be carried out under all circumstances,

and in my opinion the practitioner who loses a patient in childbed without having used even these most simple and elementary precautions cannot be said to have performed his whole duty toward his patient and to be free from any responsibility for her death.

If the treatment even takes a little more time or costs the physician a few cents, he has, on the other hand, the advantage that no kind of disease in his practice prevents him from attending to midwifery cases. If for no other reason, he ought to use antiseptics out of consideration for the consultant physician whom perhaps later he has to call in to help him. How often does it not happen that patient and doctor in the beginning of labor do not anticipate any trouble, and that later operations become necessary which the first incumbent does not feel competent to perform! And the prognosis of any kind of operative interference—nay, even the choice of the operation—*e. g.* between the improved classic Cæsarean operation with its comparatively good prognosis and Porro's operation by which 50 per cent. die, depends to a great extent on the use or neglect of true antiseptic precautions.

III. CURATIVE TREATMENT OF PUERPERAL INFECTION.

Formerly, a great many methods and remedies were used in the treatment of puerperal infection. Acting under the impression that a deleterious fluid was circulating through the body, every means was used to eliminate it. The patient was bled, salivated, made to vomit, and purged. Counter-irritation was used in the shape of large blisters. The tympanitis was combated with layers of collodium. Salivation and emetics have been entirely discarded as worse than useless. General bloodletting from the arm has followed them. Local abstraction of blood by means of leeches or cupping is hardly used in this country. The purgative method has been relegated within very narrow limits. All that remains of it is the emptying of a full intestine, and in most cases we prefer to reach this end by means of enemata. Large blisters covering the whole abdomen are never used nowadays. Smaller ones may yet be applied by some practitioners to combat cellulitis. I never use them. The painting of the swollen abdomen with collodium only increased the pain, and could, of course, not exercise any salutary influence on the disease itself.

As the patient is in a more or less weak condition by having recently gone through the pains of labor and from loss of blood, and as the infection tends to prostration of the vital forces, we should carefully avoid any kind of treatment that may weaken her either by abstraction of constituent parts of her organism or by depression of her nerve-power.

Since we know that in the vast majority of cases the disease is due to the entrance of microbes through the wounds of the genital canal, a

double indication presents itself at a glance : first, to close the gate in the face of the enemies that are yet outside ; and, secondly, to throw those out which have already gained access to the fortress. The first of these indications is met by washing the vulva, the vagina, and the uterine cavity with an antiseptic fluid, and by sealing the openings of the veins, lymphatics, and the interstices between the bundles of connective tissue by means of cauterization. The second can only be met by general treatment ; and in this respect we can hardly do more than to sustain the vital forces while the system frees itself from the microbes and the poison engendered by them.

No birth takes place without tears or abrasions of the genital tract ; but if the labor has been conducted according to the principles laid down in the preceding pages, these wounds are in an aseptic condition, and are kept so until they are healed or granulation is far enough advanced to place a powerful barrier in the way of infection. Minor wounds do not call for any treatment besides the application of the antiseptic pad described above. Larger tears are almost exclusively found in or in connection with the perineum, but their repair is considered in other places.

In the following I shall try to describe in detail the way of treating puerperal infection. For clearness' sake I divide the subject according to the parts affected, but the reader must bear in mind that it is all one and the same disease, only differentiated by the intensity of the infection or the peculiar structure and function of the part in which localization takes place. A method of treatment which is discussed under the heading of the condition in which it is mostly used may therefore be as well applicable when other organs are so prominently affected that their names are used for a new heading. When, for instance, antipyretics are discussed under Peritonitis, what is said there applies, of course, whenever the object is to reduce the temperature, whether the peritoneum is inflamed or not.

Sometimes the lochia become fetid, or there may be a moderate rise in the temperature, below 102° Fahr., acceleration of the pulse and the respiration, and yet no tenderness found anywhere, nor any abnormality detected by means of the speculum. This condition is probably due to a very mild degree of infection, sometimes connected with the presence of a clot in the uterus or the vagina, and is, as a rule, remedied by the administration of vaginal injections every three hours, five grains of quinine three or four times a day, and an aperient.

VULVITIS AND VAGINITIS.—The catarrhal inflammation calls only for vaginal injections with creolin or carbolic acid (2 per cent.), three times a day. Simple ulcers may besides be dusted with iodoform or covered with iodoform ointment. (℞. Iodoformi, ʒj ; Bals. peruv. ʒij ; Vaselinæ, ʒj).

If the sores in the vulva and vagina become diphtheritic, I touch them with a solution of chloride of zinc in equal parts of distilled water, which is applied by means of absorbent cotton wound round the end of a wooden stick. In private practice such sticks are easily obtained from the nearest butcher-shop, where they are used as pins to keep the meat together, or penholders or lead-pencils may be used. The caustic ought to be kept in contact with the wound for a minute. After that the vagina is thoroughly syringed with some reliable and safe antiseptic fluid, such as creolin, carbolic acid, acetic acid, or hydro-naphthol—not bichloride of mercury, for reasons given in treating of the prophylaxis.

If the perineum has been stitched, the sutures must be removed, for the wound is either already infected or will soon be so. The sores in the deeper part of the vagina can only be reached when the parts are exposed with a speculum. If the surfaces to be touched are not very small, it is advisable to anæsthetize the patient, as the application is rather painful. After the cauterization the parts are dressed in the usual way.

The vagina ought to be syringed every three hours, and examined once in twenty-four hours for new patches. If any are found, the same procedure is gone through again.

The first effect of the chloride of zinc is to bring the diphtheritic infiltration out much more distinctly, as it assumes a nearly milk-white color. Later, a grayish slough is formed, which is very like the diphtheritic patches. In order to distinguish old cauterized places from new diphtheritic infiltrations the physician must remember where he applies the caustic and pay attention to the outline of the sore. The slough due to cauterization has a plain curved line, while if the diphtheritic inflammation spreads the progress is somewhat uneven on different points, so that the line of demarkation becomes scalloped.

The object of this cauterization with chloride of zinc is both to kill the microbes found on and near the surface of the wound, and to seal all the canals leading from this surface into the interior of the tissues. I have found the chloride of zinc much more effective for this double purpose than tincture of iodine, iodoform, and liquor ferri subsulphatis or perchloridi.

The general treatment consists in the administration of an aperient if the bowels have not moved freely, five grains of quinine four times a day, and some strong alcoholic stimulant, such as whiskey or brandy, half an ounce, a little diluted with water or milk, every two hours. For a change the alcohol may be administered in the shape of egg-nog. If liquor is not well borne, it may be replaced by port wine in a corresponding dose, but, as a rule, large amounts of the strongest drinks can be given in puerperal diphtheria without producing intoxication.

If there is gangrene of the vulva or vagina, the general treatment is essentially the same as that here described, but the use of tonics and stimulants should be pushed somewhat more. The local treatment consists only in injections and dressing with creolin until a line of demarcation is formed. As soon as feasible the dead tissue is removed, and sometimes regeneration may be promoted by the use of iodoform or camphor. (See under "Bed-sores.")

ENDOMETRITIS AND METRITIS.—If subinvolution, tenderness, and the discharge of a dirty, offensive fluid show that the uterus itself is implicated, the first question is whether the uterus is empty or not. If there is any doubt in this respect, the patient should be anaesthetized, placed on her back on a table, the knees held bent by two assistants, the buttocks drawn to the edge of the table, the disinfected hand lubricated with carbolized mollin (5 per cent.) or glycerin (3 per cent.) brought into the vagina, and one or more fingers or the whole hand introduced into the cavity of the uterus. While the other hand, placed on the fundus, steadies the uterus and presses it down against the one in the interior, the internal surface is scraped with the nails. It is a great advantage if we can enter at one end and separate the whole foreign body in one piece, but often this can only be done piecemeal. It is, however, not necessary to remove the hand. By pressing the fingers with the loosened tissue against the hollow of the hand it is made to descend along the arm, and the operator goes on separating the next part.

If the uterus has contracted so much that the hand cannot be introduced, and if we cannot remove all with the fingers alone, a very useful instrument is the large dull wire curette originally introduced in gynecology by Dr. T. G. Thomas. (See *SYSTEM OF GYNECOLOGY*, Vol. I. Fig. 171.) For obstetric purposes it is fourteen inches long—has a shaft a quarter of an inch thick and an eye admitting the top of the thumb. In using this instrument I place the patient on her left side, the knees drawn well up, and direct an assistant to make counter-pressure on the fundus. This instrument, introduced at the edge of the part to be taken away and carefully moved sideways, has often answered an excellent purpose in my hands as early as the third month of pregnancy, interrupted by abortion. At a still earlier period, when Thomas' curette does not enter, I use Récamier's. Whenever it is possible, at least one finger ought to be introduced, besides Thomas' curette, both to feel the part to be removed and to aid in its removal, the part being seized between the finger and the curette, which is safer than to use either the curette alone or a placental forceps.

When the internal surface feels smooth the patient is turned on her back and an antiseptic intra-uterine douche is given. If there is much bleeding, the injection ought to be hot, as described above. Otherwise,

a lukewarm solution is preferable if no anæsthetic is used, as the hot water causes great pain when it comes in contact with the raw surfaces. Since creolin has such marked hæmostatic power, the temperature of the water need not be so high if that drug is used.

The uterus being empty and disinfected, it is best in confinement cases to introduce a suppository with iodoform. In abortion cases I do not use any, and have never felt the need of any such medication. In confinement cases these suppositories present the great advantage that the intra-uterine douche need not be repeated so often—as a rule, only once in twenty-four hours. This ought to be continued as long as there is a dirty discharge from the womb, and after every injection a new suppository is put in. As a 2 per cent. creolin emulsion has itself a grayish color, like coffee with much milk, it prevents one from judging of the secretion and small shreds found in the interior of the uterus. In this particular case I prefer, therefore, carbolic acid (2 per cent.). A Cusco's speculum or one of its modifications (see GYNECOLOGY, Vol. I. p. 305, Fig. 117) is introduced: the suppository is seized with a pair of forceps bent as the intra-uterine tube,¹ and introduced up to the fundus of the uterus. In order to be sure of getting into the interior of the body of the womb, the distance from the proximal end of the speculum to the fundus should be measured with the forceps before introducing it. A common dressing-forceps cannot be used for this purpose. It only wounds the womb, and cannot be brought in deep enough. The suppository ought to be so hard that it does not bend. I have found the following composition very good:

R \bar{y} . Iodoformi,	3v ;
Amyli,	3ss ;
Glycerinæ,	fl. 3ss ;
Acaciæ,	5j.

S. Divide in three suppositories of the size and shape of the little finger.²

Sometimes it is not necessary to repeat the intra-uterine treatment at all, the general condition being satisfactory. Then vaginal douches are substituted. They are likewise used as a supplement to the intra-uterine injections, and are repeated every three hours.

Involution is promoted by ergot or faradization. The latter ought only to be applied on the outer surface, one pole at the fundus, the other above the symphysis, as the internal application opens the door for new infection.

The inflammation, and especially the tenderness, are combated by placing an ice-bag above the symphysis. Four layers of muslin

¹ I have had such forceps made by Hazard & Co. (Ford).

² Modified from Ehrendorfer, *Archiv für Gynäkologie*, 1884, vol. xxii. p. 84.

or two of flannel are inserted between bag and skin in order to avoid local freezing. Ice is preferable to warm poultices, because it soothes the pain more and abridges the course of the disease. It seems even to possess direct antiseptic properties, since, according to experiments, certain microbes only grow at the temperature of the body.¹ Poultices, are, however, to be used when the ice is contraindicated; for instance, by diarrhœa, great debility or low local vitality, as in puerperal diphtheria.

The ice-bag is continued day and night as long as there are considerable pain, tenderness, and fever. When the disease takes a more subacute course I substitute Priessnitz's compress—*i. e.* a towel wrung out of cold water, which is applied to the lower half of the abdomen and covered with some waterproof fabric, under the belly-binder. It is changed four times in twenty-four hours. It gets warm in a few minutes, and this transition from cold to heat is a powerful absorbent.

Internally, five grains of quinine from four to six times a day, small doses of morphine, and a moderate amount of stimulants are given.

If the inspection of the cervical mucous membrane shows *diphtheritic* infiltration, the treatment is more energetic. Then the whole cervical membrane up to the internal os is thoroughly cauterized with chloride of zinc, as described in speaking of the vagina, the uterus washed out with antiseptic fluid, and the iodoform suppository introduced. In this case the intra-uterine injections have always to be repeated, but when the iodoform suppository is used it suffices, as a rule, to do it once a day. Before I used the suppository it was necessary to repeat the injection every few hours. The treatment is kept up until the sloughs come off and the fever ceases.

In puerperal diphtheria I prefer warm poultices to ice-bags, on account of the tendency to disintegration of the tissues. The general weakness calls for much larger doses of alcohol than where the disease is limited to the vulva or vagina. At least half an ounce should be taken every two hours. Digitalis may also be needed as a cardiac tonic. The best preparation has proved to be the infusion of the leaves (℥ss—℥vj, a tablespoonful four times a day). If the patient cannot swallow or rejects medicine from the stomach or a prompt effect is required, the tincture is given hypodermically in doses of five to fifteen minims, and repeated according to circumstances. Tincture of strophanthus in five-drop doses is also a valuable heart tonic.

Quinine is only given, as heretofore, in moderate doses, not with a view of reducing the temperature, but as a tonic and antiphlogistic, as one of the properties of this valuable drug is to prevent the emigration of the leucocytes from the veins and capillaries.²

¹ Zweifel: *Archiv für Gynäkologie*, 1885, vol. xxvii. p. 315.

² C. Binz: *Grundzüge der Arzneimittellehre*, Berlin, 1874, p. 109.

In *dissecting metritis* there elapses often so long a time before the separated portion of the uterus is expelled that the more energetic but poisonous antiseptic injections are not well borne. In such cases I have with advantage substituted the saturated solution of boric acid, and would now use creolin in a 2 per cent. emulsion. This, like all other fluids used for intra-uterine injections, ought to be warm. At the time when we used a dilute solution of chloride of zinc for intra-uterine injection we had a case of collapse and death following so immediately upon the injection of the cold fluid that a connection between the two could hardly be doubted.

Putrescence of the uterus is a condition that is hardly ever found nowadays: it belongs to preantiseptic times. If a case should come under observation it ought to be treated with intra-uterine douches of creolin frequently repeated, iodoform suppositories, and large and frequent doses of alcohol and quinine.

CELLULITIS AND ADENITIS are treated with the ice-bag, followed by Preissnitz's compress. If a swelling remains after the pain has subsided, I paint the corresponding part of the abdominal wall with tincture of iodine, and when, after a few days, the epidermis has become hard, I cover it with a piece of lint soaked in glycerin and water, equal parts, with 2 per cent. of carbolic acid. The effect of this is to promote absorption and permit an uninterrupted use of the iodine, whereas otherwise the skin cracks and it becomes necessary to discontinue the iodine, at least temporarily.

When the inflammation assumes a more chronic course the tincture of iodine is painted every third day on the vaginal vault, when it comes in more direct communication with the affected parts. This is, of course, done with a speculum, preferably Sims', and care should be taken to avoid the lower part of the vagina, the vulva, and the skin, where it smarts, while it is not felt at all at the vault. In patients who move about it is even wise to wipe off the redundant tincture with a little absorbent cotton, so as to prevent it from running down to the sensitive parts. I use the plain tincture of the United States Pharmacopœia, since once I saw ulcers produced by using Churchill's stronger solution.

Some use blisters or blue ointment, in the hope of scattering the inflammation: of late years I have entirely abstained from them. Blisters are painful, lower the vitality, and sometimes give rise to urinary trouble. Mercurial ointment, in such doses that it has any influence on the swelling, is very apt to cause salivation; and neither blister nor ointment has given me so good results as the other remedies.

If the inflammation becomes suppurative, the process may be shortened by the application of warm linseed-meal poultices, and as soon as

fluctuation can be made out the abscess ought to be opened with the bistoury. In doubtful cases it is advisable to clear the diagnosis by means of a well-disinfected aspirator-needle, and when pus is present to use the needle as a guide for the knife. In larger abscesses one or more soft-rubber drains are left to ensure a free discharge. If the incision is made from the skin, this is of course disinfected, and the wound treated according to the general rules of antiseptic surgery. If it is in the vagina, all that can be done is to rub the vaginal mucous membrane with solution of bichloride of mercury or creolin before incision, to wash out the cavity of the abscess with creolin, use vaginal injections with the same, and put on the perineal pad.

If an abscess communicating with the intestine does not close, it is necessary to make a counter-opening to the skin. The internal treatment is the same as above.

LYMPHANGITIS.—In lymphangitis of the vulva and the groin, these parts are covered with compresses dipped in a lead-and-opium wash (Tr. opii. ʒss; Liq. plumbi subacet. dil., ad viij.). If an abscess seems to form, it is treated as just mentioned in speaking of Cellulitis. General treatment is hardly required.

Lymphangitis of the uterus is treated with an ice-bag, as described under Metritis. The bowels are kept open. Quinine, alcohol, and morphia are administered, as in other inflammations.

PERITONITIS.—The chief remedies to combat this dangerous form of puerperal infection are antiseptic injections, ice-bags, opiates, and alcohol.

Some think that, absorption having already taken place, it is useless to wash out the uterus; but since the source of the poison in the vast majority of cases is in the uterus, and since its absorption is likely to go on, it seems rational to me to begin treatment by a thorough disinfection of the uterine cavity. As, on the other hand, absolute rest is of great importance, I do not repeat the injection in this form of the disease.

Two large, flat rubber bags are placed on the abdomen, and kept well provided with ice. In order to take off part of the weight of the ice, the bags are suspended to a cradle placed over the abdomen, and the remainder is not felt on account of the stupefying effect of the narcotic.

Instead of the ice-bag, a rubber coil with running ice-water may be used, but has not appeared to me to present any advantages. It is more troublesome to put up and keep in order, and is rather expensive. If it is used, a pail with ice-water must be placed at a suitable height above the patient. Into this the afferent end of the tube with a strainer should be plunged. From the other end the water runs

into another pail placed under the bed. If, exceptionally, cold is contraindicated, warm poultices may be substituted.

The opiate I prefer is Magendie's solution (two grains of sulphate of morphine to a fluidrachm of distilled water). In order to relieve the patient as soon as possible from the severity of her pains, the treatment is best begun with a hypodermic injection of a quarter of a grain. If this does not suffice, smaller doses are added. When once relief is obtained, I prefer to give the drug through the month, in doses of one-eighth to one-fourth of a grain, about every half hour until the patient is fully under its influence. In my opinion, the administration through the mouth is preferable, because the drug comes in more direct contact with the diseased parts; because I have seen the opening made by the needle of the hypodermic syringe become the starting-point of a fatal infection, and often give rise to abscesses; and, finally, because the injection ought only to be made by a doctor, who, as a rule, cannot be in so constant attendance, whereas a reliable nurse may be intrusted with the administration through the mouth. If the morphine is rejected from the stomach, it must be given hypodermically, but the drug itself has great power to restrain vomiting. In the respiration we have a reliable guide as to the limit of safety. It is safe to use the remedy with such short intervals until the number of inspirations sinks to fourteen or even twelve per minute. Then longer intervals are called for. The condition we want to produce is freedom from pain, and yet not greater stupor than that from which the patient can be easily roused.

Through the influence of Mr. Tait peritonitis is now often treated with aperients and opium proscribed. While this may be preferable in that form of the disease which follows gynecological operations, and probably owes its effects to the removal from the system of septic material, I can only warn against it in puerperal peritonitis. When I was a student this disease was treated with large doses of an aperient medicine, of which senna was a chief component, warm poultices, or a coating of collodium smeared over the abdomen, and insignificant doses of opium. The aspect of the poor women who received this treatment has impressed itself indelibly on my mind as something of the most horrible I have ever seen. Lying immovable, with pinched features, turned-up eyes, shallow, panting respiration, and screaming if anybody touched them, they looked as if they were being tortured on the rack; and the only consolation was to know that they soon would succumb to the combined effects of the malady and the treatment. Young as we were, and not knowing that other remedies were resorted to in other places, it struck us students as absolutely fatal to follow this treatment, so sure were we soon to see the patients removed from the ward to the dead-house. How different it is with the "opium plan"! The patient

is free from pain, is ignorant of her dangerous condition, does not even feel the weight of the ice, and has about even chances of recovery and death.

If the morphine has a too depressing effect, especially if the action of the heart is weak, atropine may be added to great advantage. By taking 1 part of sulphate of atropine to 1000 parts of Magendie's solution, the mixture may be administered according to the rule laid down for morphine alone. Dr. T. Herring Burchard, in an excellent paper on peritonitis,¹ advocates the use of large doses of atropine—from one-sixtieth to one-tenth of a grain. I have never given more than represented by the lowest of these figures. The highest is a toxical dose,² but that does not prevent it from saving life under peculiar circumstances. Dr. Burchard warns against giving opium during the initial collapse.

Next to morphine, alcohol is the most important remedy in puerperal peritonitis. One-half to one ounce of brandy or whiskey should be taken about every two hours. Other excellent stimulants and tonics are a strong infusion of coffee, taken without milk, and strong beef tea. Excellent beef tea can be made from fresh meat by cutting it in quite small cubes; put these in a bottle with twenty drops of dilute hydrochloric acid and just water enough to bring the acid in contact with all the meat. The bottle is corked and placed in a vessel with water which is brought to the boiling-point, and kept there for an hour and a half. If more bulk is desired, the acid may be added to a pint of cold water and poured on a pound of finely-cut meat. It should stand for an hour or more, and be stirred up occasionally. Then the vessel is put over a fire until it reaches the boiling-point, when it is removed, the contents strained through a fine cloth, and salt added to taste.

Of the many meat preparations found on the market, Valentine's meat-juice seems to me to have the advantage of being very palatable. Rudisch's beef peptonoids may be used for beef tea or eaten as a solid. It is so concentrated that a single teaspoonful is quite a meal for a sick person.

I give quinine in five-grain doses every four hours.

No medicine is given to move the bowels. From time to time there will be a spontaneous discharge. Otherwise an enema is given. One I rather like is composed of an infusion of linseed meal one quart, with a tablespoonful of castor oil and a teaspoonful of spirits of turpentine. The injection of about two fluidrachms of glycerin by means of a small hard-rubber syringe has likewise, in my hands, been followed by a prompt and abundant evacuation. It softens the hardest scybala

¹ T. H. Burchard: *New York Med. Journ.*, August 15, 1885.

² "A tenth, or even a twentieth, of a grain of atropine will often produce alarming symptoms" (H. C. Wood: *Therapeutics*, 7th ed., Philadelphia, 1888).

and produces a desire for defecation. Great relief is often afforded by the introduction of a soft-rubber rectal tube, through which flatus is discharged.

As to diet, the patient receives only milk, beef tea, and oatmeal gruel. In order to give an idea of the amount of medicine and food given in peritonitis, I may mention that one of my patients in twenty-three days took 216 grains of morphine, 228 ounces of whiskey, 1078 ounces of milk, and 418 ounces of beef tea, making an average of 9 grains of morphine, $9\frac{1}{2}$ ounces of whiskey, 45 ounces of milk, $7\frac{1}{2}$ ounces of beef tea in twenty-four hours. The greatest amount of morphine given in one day was $13\frac{3}{4}$ grains.

This outline gives an idea of the way in which I treat these cases myself; but in a work of this kind it may be advisable briefly to mention some modes of treatment used by others. Some use a moderate number of leeches, say eight or ten, or take some blood by cupping: it relieves pain and combats inflammation, but it weakens the patient. Bloodletting from the vein has been entirely abandoned.

As to blisters and blue ointment, I refer to what has just been said under the heading "Cellulitis."

Emetics are likewise very depressing, and we cannot in that way deliver the patient of the poison that threatens her life.

I have already spoken of purgatives.

Some use aconite or veratrum viride. The latter drug is much praised by Dr. Fordyce Barker in his *Lectures on Puerperal Diseases*. Of this class of drugs, heart sedatives, digitalis is most used nowadays. Having spoken of it under Metritis, I refer the reader to that division.

Many use antipyretics extensively—quinine, salicylate of soda, and antipyrine. To give large doses of these drugs seems to me rather to mask the disease than to cure it. The small doses of quinine I use have hardly any direct influence on the temperature, but keep the whole system under the tonic and antiphlogistic influence of this valuable remedy. Salicylate of sodium is a very debilitating drug, and, as the chief indication is to keep up the flagging strength of the patient, I am not in favor of its use. Antipyrine I have occasionally used in fifteen-grain doses, with good effect so far as the lowering of the temperature goes, but otherwise it does not seem to have any virtue. Among the antipyretics I would likewise place carbolic acid. Given in minim doses every hour in a mucilaginous mixture, it has a decided influence on offensive diarrhoeal discharges and lowers the temperature.

A valuable means of reducing the temperature is cold. If, in spite of intra-uterine tonic and sedative treatment, the temperature remains high, in the Maternity Hospital we use frequent sponging of the whole body, either with cold water alone or a mixture of water and alcohol.

This procedure can be carried out without disturbing the patient, and is rather grateful to her. The same cannot be said of the cold pack and the cold bath; but then they are much more powerful and have been highly recommended. If the cold pack is resorted to, it ought to be administered in the following way: Two beds are needed. They are covered with rubber sheets or oil-cloth and a blanket. A muslin sheet is wrung out of cold water and spread over the bed. The patient is lifted over on the sheet, which is wrapped round her, leaving the feet free. If the circulation is bad, it may even be necessary to apply hot bottles to them. A blanket or two are laid over all. At the end of about ten minutes the patient is removed to the first bed, which in the mean time has been prepared in the same way. Four or six packs are needed to make an impression on the temperature if the fever is high.

A better way of administering cold is by means of Kibbee's fever-cot, consisting of a wooden frame to which is attached a cotton netting, and under that a rubber sheet adjusted in such a way as to lead water into a pail placed at the end of the cot. Dr. T. G. Thomas has spoken very highly of this apparatus.¹ He describes its use in the following terms: "Upon this cot a folded blanket is laid, so as to protect the patient's body from cutting by the cords of the netting, and at one end is placed a pillow covered with india-rubber cloth, and a folded sheet is laid across the middle of the cot about two-thirds of its extent. Upon this the patient is now laid, her clothing is lifted up to the armpits, and the body enveloped by the folded sheet, which extends from the axillæ to a little below the trochanters. The legs are covered by flannel drawers and the feet by warm woollen stockings, and against the soles of the latter bottles of warm water are placed. Two blankets are then placed over her, and the application of water is made. Turning the blankets down below the pelvis, the physician now takes a large pitcher of water, from 75° to 80°, and pours it gently over the sheet. This it saturates, and then, percolating the network, it is caught by the india-rubber apron beneath, and, running down the gutter formed by this, is received in a tub placed at its extremity for that purpose. Water at higher or lower degrees of heat than this may be used. As a rule, it is better to begin with a high temperature, 85° or even 90°, and gradually diminish it. . . . It is better to pour water at a moderate degree of coldness over the surface for ten or fifteen minutes than to pour a colder fluid for a shorter time. . . . At the end of every hour the result of the affusion is tested by the thermometer; and if the temperature has not fallen another affusion is practised, and this is kept up until the temperature comes down to 100° or even less."

¹ *New York Medical Journal*, August, 1878.

This fever-cot seems to me the best means of applying cold to the trunk. When it is not to be obtained and general refrigeration is wanted, recourse may be had to cold baths. The patient should be placed in a bath-tub with water near or at blood-heat. She is least disturbed by lifting her on the sheet on which she lies and letting her with this gently down into the water. Then the warm water is gradually replaced by cold water until it reaches about 80°. This is a very powerful means of abstracting heat, and I have seen it save life in desperate cases; but it can only be used where a bath-tub and considerable assistance are at command. It ought only to be used under the personal supervision of the physician, as the effect has to be very closely watched. In order to prevent heart-failure it is good to give a tablespoonful of brandy before the bath, and remove the patient as soon as her condition seems to get worse. Otherwise she may remain in the water for fifteen or twenty minutes. After her removal she should be wrapped in blankets and replaced in bed.

Max Runge¹ has recently advocated a treatment embodying several points of those mentioned here. He deprecates the use of antipyretics, but praises cold baths (82° Fahr.) once or twice a day for seven minutes. He gives frequent alcoholic drinks—a bottle of port or madeira wine daily, besides five or six ounces of brandy. As it is not very likely that the so-called madeira and port at command in a German hospital have much to do with Portugal or the island of Madeira, they too may safely be looked upon as a mixture of brandy. The original point in his treatment is the free administration of food. He allows not only tea, milk, and beef tea, but eggs, cutlet, and ham. He claims 15 recoveries out of 20 patients. Of the 5 who died, 4 were suffering from uncontrollable vomiting, so that the treatment was not available. Some of the cases were evidently mild, but others with very bad symptoms, such as peritonitis, repeated rigors or localization in the lungs, were found among those who recovered.

I find hardly any reference made anywhere to laparotomy, and still I think the time cannot be far off when, guided by the experience gained in the operative treatment of both chronic and acute peritonitis, we will not allow a woman to die of puerperal peritonitis without giving her the slight chance of recovery offered by that operation. Spiegelberg² had the idea, but he did not go farther than to tap the abdominal cavity of a moribund woman, although he saw an amelioration lasting several hours follow the experiment. Sonnenburg³ performed laparotomy on a person who shortly before had given birth to a child, and in whom perimetritis had developed during the lying-in

¹ Runge: *Archiv für Gynäkologie*, vol. xxxiii. No. 1. p. 39. 1888.

² Spiegelberg: *Lehrbuch der Geburtshülfe*, Lahr, 1878, p. 754.

³ Sonnenburg: *Centralblatt für Gynäkol.*, 1885, vol. ix. p. 238.

period. A pelvic abscess ruptured into the peritoneal cavity, causing general peritonitis with collapse, when Sonnenburg opened the abdomen, from which the pus poured out in a stream, cleansed the peritoneum with a solution of salicylic acid, and inserted a drainage-tube. The patient recovered.

Tapping or aspiration can hardly be expected to do any good. If we will operate at all, it ought to be by laparotomy, and if this shall have any chance of saving the patient, it ought to be performed early, before her whole system is so poisoned that she is beyond recovery. Since we know that the microbes come from the genital canal, mostly follow the lymphatics, invade the peritoneum, and are likely to pursue their route to other organs, it would seem rational to stop their migration, turn out what we can from the abdominal cavity during the operation, and leave a permanent outlet for pus and microbes that may be formed later. The difficulty is that at the time when the operation might do the most good the patient and her friends may not realize the enormous danger of her condition, and the physician may hesitate to take the risk of an operation that is more likely to bring him blame than glory. If it were true, as some say, that general peritonitis in puerperal infection is absolutely fatal,¹ there would be more inclination toward operation, in order to try if perhaps puerperal peritonitis would yield similar results to those obtained when the disease is caused by the rupture of the intestines or the bladder, gunshot wound, etc.²

But when it is taken into consideration that a certain number of patients may recover under medical treatment, and that the shock of the operation may make the condition worse, there will naturally yet be a strong bias in favor of abstention.

When, later in the disease, there is an encysted peritonitis, there can no longer be any doubt about the advisability of performing laparotomy.

PLEURISY.—If the inflammation affects the pleura, special indications present themselves. The pain and the exudation may be combated by the application of an ice-bag if the seat of the disease is accessible without disturbing the patient and her vitality is not too low. Under the opposite conditions a warm linseed-meal poultice should be preferred. A very convenient way of applying heat to the chest is by means of spongio-piline; that is, thick felt covered with a layer of gutta-percha. It is simply dipped in hot water, retains the heat well, and is light.

Internally, diuretics may be tried, especially iodide, acetate, bitar-

¹ Siredey: *loc. cit.*, p. 211: "La peritonite partielle guérit presque toujours; la peritonite généralisée est fatalement mortelle."

² Burehard collected 39 cases with 23 recoveries, or 60 per cent., in the above-mentioned paper.

trate, and citrate of potassium, a decoction of the root of *Triticum repens*, and digitalis. A favorite formula with me is the decoction of *Triticum repens* (5j to Oj), with acetate, bitartrate, citrate of potassium (āā. 5ij). M. S. A tablespoonful four or six times a day.

The amount of fluid accumulated in the pleural cavity is rarely large enough to necessitate aspiration. In more chronic cases the empyæma operation, with resection of a piece of a rib, may be called for.

PNEUMONIA.—When the lung becomes inflamed the chest should be covered with large warm poultices. Besides quinine and alcohol, which are always in order in puerperal infection, I use ammonia. I prescribe two sets of powders—one containing ten grains of carbonate of ammonia, the other twelve grains of citric acid and as much sugar. One powder of each set is dissolved in an ounce of water, and the two poured together. Thus citrate of ammonia and free carbonic acid are formed. Be it that the salt of the mixture counteracts the formation of fibrinous plugs, as has been claimed, or that the medicine simply works as a stimulant, it seems to me to have a good influence on the pneumonia, and it is a refreshing drink to take for the patient.

As the pneumonia is mostly hypostatic, care should be taken, if the patient's condition otherwise allows it, to change her position from side to side.

The œdema that frequently accompanies the pneumonia and jeopardizes the patient's life is often successfully combated by dry cupping.

ENDOCARDITIS AND PERICARDITIS.—The inflammations of the heart in puerperal infection are hardly within reach of our therapeutic resources. All we can do is to try to give some relief by means of cold or hot applications, as in pleurisy, to attract blood from the inflamed parts to the skin by means of dry cupping, and to strengthen the heart by such remedies as digitalis or strophanthus.

ENTERITIS.—The stinking diarrhœa is best treated with one-minim doses of carbolic acid in a mucilaginous mixture, given every hour. Or the compound tincture of iodine may be administered in the same way, or both combined. Enemas of corn starch (a teaspoonful) with laudanum (twenty-five drops) give great relief when there is tenesmus. A teaspoonful of subnitrate of bismuth may be added with advantage.

HEPATITIS.—When the liver is inflamed the right hypochondrium should be covered with a warm poultice. If there is sluggishness of the bowels, calomel (five to ten grains) is preferred as a laxative, as it has a special effect on the secretion of the bile.

NEPHRITIS.—A poultice is applied to the loins. The secretion of urine is increased by digitalis, potassa salts, and dog-grass, as stated under "Pleurisy." Leaves of digitalis may be put in a bag, soaked in hot

water, and used as a poultice. If diuretics fail and there are uræmic symptoms, we try to eliminate the poison through the skin and the bowels. The first is best done by the hot-air bath, which can be improvised by placing an alcohol lamp under a chair covered with a waterproof next to the side of the bed, and an umbrella over the abdomen. The hot air rises and gets in under the bed-clothes, and soon a profuse perspiration is obtained.

The strongest purgatives, as croton oil, elaterium, or gamboge, are sometimes needed to move the bowels. Croton oil may be given in pills containing each half a minim, one pill every half hour till they operate. If the patient cannot swallow, two drops may be mixed with a little butter and rubbed on the tongue. The dose of commercial elaterium is $\frac{1}{4}$ to $\frac{1}{2}$ grain every half hour, of Clutterbuck's, $\frac{1}{8}$ grain; of elaterin, $\frac{1}{16}$ to $\frac{1}{12}$ grain. The full dose of gamboge is 2 to 6 grains, but it is better to give small doses at short intervals.

Small doses of chloral seem to have the effect of diminishing the albuminuria. I give fifteen grains every evening, and tinct. ferri chloridi, fifteen to twenty drops, four times a day. The diet should consist of skimmed or peptonized milk exclusively.

VOMITING is so troublesome a symptom that it deserves special consideration. It is more or less successfully combated with morphine, dilute hydrocyanic acid, bismuth, strychnine, tincture of iodine, carbolic acid, creasote, ice-lumps, Vichy water, etc. If the stomach cannot be quieted and the case is a protracted one, all food should be withheld and the patient fed through the rectum. Lenbe-Rosenthal's solution of meat or Rudisch's beef peptonoids are particularly well adapted for this purpose. Where they cannot be procured a pretty good nutrient enema may be composed of an egg, a tablespoonful of brandy, and four ounces of milk.

ENCEPHALITIS AND MENINGITIS.—If the brain or its envelopes are the seat of the localization, little can be done with any prospect of benefit. Still, the head should be covered with an ice-bag or Thornton's cap of rubber coil with running ice-water. Ergot and chloride of barium (twenty minims of the liquor every four hours) may be given, besides quinine, in the hope of contracting the blood-vessels and counteracting the migration of the colorless blood-corpuscles. The bromides and chloral may be called for to allay excitement. The bowels should be kept rather loose if they are not already so.

DELIRIUM is quieted by means of opiates, chloral, and bromides.

ABSCESSSES in the subcutaneous or intermuscular connective tissue are opened and treated according to the rules of antiseptic surgery.

ARTHRITIS.—If the localization takes place in a joint, this must first of all be immobilized in a proper position by means of splints and bandages; but they ought to be applied so as not to interfere with other

treatment. I have seen excellent results from the application of an ice-bag round the affected joint. Later, tincture of iodine or blisters may be of use. If pus is formed, it may become necessary to treat the joint, according to the general rules of surgery, with aspiration and irrigation with a solution of carbolic acid (3 to 5 per cent.), creolin (2 per cent.) or incision.

SKIN.—The eruptions on the skin caused by puerperal infection will hardly call for any special treatment. In cases where the patients complained of itching I have seen considerable relief from frequent washing with a 1 per cent. solution of carbolic acid. Complicating eruptive fevers will be discussed elsewhere.

Great attention should be paid to *bed-sores*. At the first warning in the shape of an even redness over the sacrum, trochanters, heels, or other parts exposed to much pressure, the affected part should be protected by placing it on an air-cushion, and the patient, if possible, should lie so as to avoid pressure on that point. For the heels there are small rubber rings to be had at the instrument-makers' or in the rubber stores, or they may be improvised by winding a strip of muslin in a spiral line around a little oakum. The affected spot should be bathed frequently with lead-water.

If the epidermis has already been lost in some places, the part should be dressed with glycerate of tannin, one part to four, or an ointment with iodoform (5j), Peruvian balsam (5ij), and vaseline (5j).

If there is gangrene, the dead tissue should be removed with seissors or the knife as soon as a line of demarcation is formed, and the ulcer dressed with pledgets of absorbent cotton or lint soaked in camphor emulsion (camphoræ, ʒss; mucilag. acaciæ, ʒj; aquæ, ʒiv), which brings on a wonderfully rich granulation. When once the hole is filled the milder remedies may be substituted. Pledgets soaked in creolin emulsion (2 per cent.) are said to have a similar stimulating effect.

A mattress filled with water proves an excellent couch in severer cases. I believe it is only in a mechanical way that the water works. The couch adapts itself better to the patient than any other mattress, so that the pressure is very even, and all movements are much facilitated by the escape of the water from the part toward which the patient moves. I mention this because I have seen water placed in a tub under the bed, or even a bed particularly made with a metal compartment in the lower part to be filled with water, in the belief that the mere neighborhood of water, without contact, exercises a beneficial effect on bed-sores.

PHLEBITIS.—1. *Phlegmasia alba dolens*.—The part should be kept immobile. The places where swollen veins can be felt are painted with tincture of iodine. The whole limb is covered with cotton, very

slightly compressed with roller bandages, and elevated on cushions. In protracted cases I have changed the iodine for blue ointment. In order to avoid the danger of tearing off a part of a thrombus by pressure, the ointment ought to be smeared on the skin only with great care.

As there is great tendency to relapse, the patient ought to be kept on a lounge or an easy-chair for a fortnight after she leaves the bed and treatment is discontinued. If circumscribed abscesses form, they are matured with warm poultices, opened, and dressed antiseptically. In the diffuse phlegmonous form several large incisions through skin and fascia are called for at an early date in order to limit the destruction of tissue.

2. *The Inflammation of Varicose Veins* is also treated with absolute rest and elevated position. The affected part is covered with compresses soaked in lead-and-opium wash. The effect is greater if they are kept cool, but in this we may conform to the wishes of the patient. Sometimes warm linseed-meal poultices have a more soothing effect. When all pain is gone compression may be used to reduce the swelling. At first the limb is enveloped with a roller bandage. Later, when the patient is up and about, an elastic stocking is preferable.

3. *Uterine Phlebitis* calls for all the local and general treatment we have described in the preceding pages, according to the special features every case presents, especially ice-bags or poultices, quinine, and alcohol.

ACUTEST SEPTICEMIA.—In those cases which have so rapid a course that the usual organic changes do not find time to take place before the patient succumbs, therapeutics are, of course, nearly powerless. Still, in order to give the patient whatever chances we can, we will go to work according to the principles laid down above. We will especially disinfect the parturient canal, moderate the high temperature, give large and frequent doses of quinine, alcohol, digitalis, and atropine, and relieve pain and excitement by means of the hypodermic injection of small doses of morphine.

INFLAMMATION OF THE BREASTS AND ALLIED DISEASES CONNECTED WITH CHILDBIRTH.

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SORE NIPPLES.

DURING lactation the nipples become the seat of several diseased conditions which commonly are united under the general term "sore nipples." The most common form is an abrasion due to the loss of the epithelium on a more or less roundish surface near the upper end. In other cases linear ulcers are formed, especially near the base. These may become so deep that the nipple remains only attached by a few lactiferous ducts, or is even entirely torn off. The nipple may be the seat of simple granulating ulcerations or the specific ulcer of syphilis. An eczema is sometimes developed here as well as on the areola.

The predisposing cause of common sore nipples is the thinness of the epithelium and the shortness of the nipple. These conditions are often themselves due to neglect during pregnancy. If the nipples are not kept clean, drops of milk and old epidermal cells often form together a crust, under which the epithelium atrophies and becomes excessively tender. The pressure from stiff corsets prevents the physiological growth and increased prominence of the nipple by which Nature prepares this organ for its function during lactation.

The direct cause is probably the injury brought on by the child biting the nipple with its gums and licking it with its tongue—acts which will be so much more liable to tear off the epithelium and attack the deeper tissue as the part is constantly bathed in milk, and has to be kept warm in order to avoid other trouble.

Others think that the mechanical injury is of little or no account, and attribute the excoriations and ulcerations exclusively to the presence of vegetable parasites. Ign. Berger¹ found in every case in the beginning *oïdium lactis*, which he believes is identical with *oïdium albicans*.

Some think a child with sprue may cause the sore nipple, but others

¹ Berger : *Centralblatt für Gynäkologie*, 1884, vol. viii. p. 819.

pretend that it is more likely the sprue is the secondary affection brought on by sucking a breast which contains the oïdium.

The eczema seems to be the result of lack of cleanliness. I have only seen it in private practice among the lower classes, never in well-to-do private patients nor in the Maternity Hospital. It is independent of eczema in other parts of the body.

The syphilitic ulcer is mostly caused in a healthy nurse by the bite of a syphilitic child.

A sore nipple causes great pain when the child nurses, may produce great nervous irritability, even in the intervals between nursing, by the mere thought of the ordeal to be encountered, and may be accompanied by a rise in temperature up to 104° Fahr.—a circumstance which it is good to bear in mind when all other causes of fever can be excluded.

Sore nipples, besides being in themselves a painful affection, may become the source of mastitis, and the greatest attention ought therefore to be given both to their prevention and their cure.

TREATMENT.—The preventive treatment should begin during pregnancy. The nipples and the nearest part of the areola ought to be washed once a day during the last two or three months with some astringent or spirituous fluid. Brandy or whiskey undiluted, or alcohol mixed with equal parts of water, is as good as any. With more refined women cologne is preferable, on account of its pleasant odor.

If there are scabs on the nipples, they ought to be softened by some suitable application—for instance, lead-water and thin oatmeal gruel, equal parts—and removed before beginning the hardening treatment.

Small nipples may be made longer by cautiously pulling on them with the thumb and two fingers for a minute or two every day. This manipulation is, however, apt to cause uterine contraction, and would therefore be contraindicated in a person suffering from habitual abortion.

During the latter half of pregnancy women ought only to wear entirely soft and yielding corsets and loose dresses which cannot exercise any pressure on the nipples.

As curative treatment a great many drugs and appliances have been recommended. Our treatment in the Maternity Hospital is very simple, and at the same time so effective that we entirely avoid mammary abscesses. As soon as there is the slightest erosion of the nipple it is dusted with dry tannin and a small circular piece of lint is placed over it. In order to prevent this from sticking, it is smeared with a little glycerin or vaseline, and kept in place by the jacket to be described under "Mastitis." The tannin forms a kind of artificial epidermis over the denuded place, that does not even come off when the nipple is washed, which is done before and after each nursing. Very often the affection heals under this treatment, although nursing is continued.

If the sore is large and the pain considerable, nursing is interrupted for a shorter or longer period, the maximum being four days, and the breasts are relieved by milking them with the fingers, much in the same way as milk is drawn from a cow's udder. The difference between this and nursing is that the nurse who milks out the breasts carefully avoids touching the sore places. On the other hand, this is entirely different from, and much preferable to, the coarse kneading of the breasts which was used in the hospital until I first began to regulate the breast treatment, and also to all kinds of breast-pumps, which hurt the patient and by the pressure exercised by their edges on the breast around the nipple rather promote than prevent mastitis.

A soft-rubber nipple-shield, kept scrupulously clean with carbolized and plain water, offers sometimes a grateful protection for the sore nipple during lactation; but often the baby, in spite of all coaxing, cannot be made to suckle through it.

These are all the measures we take to cure sore nipples, and the result is most satisfactory. Of the many other ways of treating them I may mention a few. A 5 per cent. solution of carbolic acid is used on compresses to cover the nipple with,¹ or simply applied with a camel's-hair brush.² This is a rational treatment for those who look upon the disease as the work of microbes, but a solution of that strength smarts considerably in an open sore, and any kind of fluid is, in my opinion, less good than the dry treatment, because it macerates the epithelium and is apt to make the condition worse rather than better. Another favorite remedy is nitrate of silver, either as a solid stick, with which the sore is touched, or as a solution, which is painted over it. It combines the two good properties of being an astringent and an antiseptic, but it is exceedingly painful. A remedy I have not seen mentioned, but which I would try if I needed to look round for something new, is chloral hydrate. Since in a 4 per cent. solution it works on anal fissures like a charm, I do not see why it should not have a similar effect on mamillary fissures. It has great antiseptic power and combats pain. Compound tincture of benzoin was formerly the remedy used in Maternity Hospital. I have seen vaseline have an excellent effect. Collodium, goldbeaters' skin, plaster strips, have been used to form a cover over the whole or part of the nipple, but fail to offer the protection sought.

If granulating ulcers resist the milder treatment recommended above, it may become necessary to touch them with lunar caustic.

Syphilitic ulcers call for local and general specific treatment according to the rules of treatment for that disease. If a syphilitic child is the cause of a syphilitic ulcer on the breast of a nurse, there is nothing

¹ Haussmann: *Centralblatt für Gynäk.*, 1878, vol. ii. p. 233.

² Steiner: *Ibid.*, p. 402.

gained by weaning it; but if such ulcers should appear from any other cause, the child ought in its own interest immediately to be taken away from the nurse. If the relations are those of mother and child, lactation may continue, for the milk cannot bring more poison to the child than the blood from which its body has been formed, unless the disease has been contracted after the birth of the child.

Eczema is best treated with the mixture of lead-water and oatmeal mentioned above until all scabs have come off, and then with diachylon ointment, and finally with a powder of zinc oxide and starch: (R̄. *Zinci oxydi*, ʒj; *amyli*, ʒj. M.). If there is much itching, camphor, ʒj, may be added, or if the skin is healed a lotion with carbolic acid may be substituted (R̄. *Acidi carbolici*, flʒss; alcohol, glycerinæ, āā. flʒss; aquæ, ad flʒvj.)

DEEP INFLAMMATION OF THE NIPPLES.

Velpeau¹ has described an inflammation of the deeper part of the nipples which he says is rare. It may attack the lactiferous ducts or the intermediate connective tissue.

The first kind shows a more benign nature, causes only moderate swelling, and ends in small abscesses containing bluish, milky pus, which sometimes is seen to dribble from the nipple. If the child continues nursing it may swallow more or less of this matter, and consequently this form of inflammation is very dangerous for it.

The second kind, which has its seat in the connective tissue, is more painful, is accompanied by more rapid and more considerable swelling, and forms a globular abscess filled with thick, creamy pus, which is not evacuated through the normal apertures of the lactiferous ducts, and therefore is not so liable to be swallowed by the child.

If they do not soon end in resolution, both kinds of inflammation become so painful that suction is intolerable. When suppuration is established in the inflammation of the lactiferous ducts, the pus can only be evacuated through their normal apertures on the top of the nipple; in that of the connective tissue it breaks through or is opened artificially in the circumference, and soon dries up.

TREATMENT.—Lactation must be interrupted for a few days. Resolution may be attempted by means of mercurial ointment, iodide-of-lead ointment, a warm poultice, or the lead-and-opium wash; but the ice-bag would probably here, as in the inflammation of the breast itself, prove better than any other treatment. If suppuration is inevitable, the poultice favors the ripening of the abscess. If the abscess is situated in the ducts, nothing more is to be done; if in the connective tissue, it ought to be opened with the knife as soon as possible, and dressed with gauze wrung out of creolin or carbolic-acid solution (2 per cent.).

¹ A. Velpeau: *Traité des Maladies du Sein*, Paris, 1854, pp. 15, 16.

ECZEMA OF THE AREOLA.

The areola, as well as the nipple, may be the seat of an eczema characterized by the formation of yellow or brown scabs, which irritate the patient by itching, and often resist treatment for some length of time. The treatment is the one just described in speaking of the same condition in the nipples.

CELLULITIS AND ADENITIS OF THE AREOLA.

The connective tissue under the areola and the sebaceous glands forming small prominences on the surface of this part may become inflamed and produce little abscesses. The skin reddens, small lumps are formed which are tender to the touch, and there are more or less pain and fever. If suppuration sets in, a yellow spot appears in the centre of the nodules; one or more openings perforate the skin, and leave a deep ulceration, followed by an unseemly scar or a hard nodule slow to disappear. This condition is chiefly due to the injuries caused by the attempts of the child to nurse from too short nipples (Winkel), but may also, like other inflammations of the breast, originate in sore nipples.

TREATMENT.—The disease can to a great extent be prevented by proper attention to the nipples. I have not seen a case for years, since the introduction of the above-mentioned treatment of the breasts.

Resolution may be attempted by means of the iodide-of-lead ointment or plaster and attention to sore nipples.

If suppuration is established, the small abscesses should be laid open without delay, and the breast covered with a thick gauze pad wrung out of a solution of creolin or carbolic acid (2 per cent.), when they heal in a few days.

ERYSIPELAS OF THE BREASTS.

Before the change of the service in the Maternity Hospital erysipelas of the breast was by no means a rare disease in our wards, and I have even seen it end fatally. It starts from excoriations of the nipples or a mammary abscess. Since Fehleisen has succeeded in finding the specific germ of erysipelas, we know that it is an infectious disease. The skin becomes dark red, hot, swollen, tender on pressure, and surrounded by the distinct boundary-line characteristic of the disease. It is accompanied by high temperature and the other symptoms of fever. In most cases it ends in desquamation. Sometimes it becomes bullous or gangrenous, and at other times it becomes complicated with inflammation of the cellular tissue.

TREATMENT.—Nursing from the sick breast must be discontinued,

at least for a time, and in bad cases from both breasts. Internally, the tincture of chloride of iron should be given in large and frequent doses, say twenty drops every two hours. Externally, compresses dipped in ice-cold carbolized water, 1 or 2 per cent., or an ice-bag, gives relief and seems to localize and shorten the disease. I have seen betanaphthol (gr. xxv. to ʒj of vaseline) arrest it. From the experience I recently have had with creolin in a case of facial erysipelas I would now prefer this substance to all others. It is smeared, undiluted, with a camel's-hair brush over, and one inch and more beyond, the affected surface morning and evening.

Bullæ ought to be opened and dressed with iodoform in powder, or, if the denuded surface is too large, with iodoform-vaseline (ʒj to ʒij).

In the gangrenous form dead tissue is removed and the part dressed with lint, gauze, or absorbent cotton soaked in camphor emulsion (℞. Camphoræ, ʒss; mucilag. acaciæ, flʒij; aquæ, flʒiv), or a solution of creolin (2 per cent.).

LYMPHANGITIS OF THE BREASTS.

According to Sappey,¹ there are in the breast two layers of lymphatics—a superficial or cutaneous layer, composed of a very delicate network covering the nipple and the areola; and a very rich deep or glandular layer, which envelops all the lobes and lobules of the mammary gland with its radicles. The trunks starting from this layer run from the posterior surface and the interior of the gland to the areola, where they form a plexus remarkable for the enormous volume of the vessels of which it is composed. From this plexus start two or three voluminous trunks which open in the lymphatic glands of the axilla.

In rare instances these latter trunks become inflamed, and appear on the skin as red, tender streaks extending from the nipple to the swollen axillary glands. This condition is accompanied by pain and fever.

The cause is an infection of sores on the nipple. In most cases the inflammation ends in resolution, but it may become suppurative, forming one or more small abscesses.

TREATMENT.—An even compression is instituted by means of the breast-binder to be described under "Mastitis," and an ice-bag applied outside of that and kept in place by means of a piece of muslin surrounding the chest and held together with safety-pins.

Internally, quinine is given in five-grain doses every four hours.

Nursing from the sick breast must be discontinued, at least provisionally.

If suppuration sets in, the small abscesses are opened and dressed

¹Sappey: *Traité d'Anatomie descriptive*, Paris, 1857-64, vol. iii. p. 698.

with a pad of gauze wrung out of a solution of carbolic acid or creolin (2 per cent.), under which treatment they heal in a few days.

Maybe there is a similar affection of the deep lymphatics, but that can hardly be distinguished from mammary and submammary cellulitis.

MASTITIS.

Mastitis, or inflammation of the breast, is vulgarly called a weed in the breast.¹

The right breast is more frequently affected than the left. Sometimes both are inflamed.

It is common, and of practical value in regard to symptoms and treatment, to distinguish three varieties as to the seat of the inflammation, viz. : the *subcutaneous*, the *glandular*, and the *subglandular* varieties. Of these the glandular is by far the most frequent.

ETIOLOGY.—One point has struck all observers: the disease is found almost exclusively in nursing women. It is exceedingly rare in puerperæ who never attempt the act of lactation, and in pregnant women. Its appearance, independently of gravidity and the puerperal state, lies without the scope of this article. On that subject the reader may find some information in the *System of Gynecology*, Vol. II. pp. 349–351.

When once it is conceded that mastitis is almost exclusively found in women who nurse their children, the next question that presents itself is, How does the act of lactation cause the inflammation of the breast? The most popular belief is that it is due to refrigeration; but, although exposure once in a rare while may cause an inflammation here as in other parts, the mere fact that the disease is entirely independent of season and climate goes far to show that cold has a very limited part in its production.

Among physicians it used to be the generally accepted opinion that mastitis was caused by stagnation of the milk in the lactiferous ducts. This theory is based on the observation that the inflammation is often preceded by a general or partial swelling of the breast, which is relieved by emptying the lactiferous ducts. It cannot, in justice, be said that it is disproved by the fact that mastitis is hardly ever found in puerperæ

¹ *Medical Register*, March 9, 1889, edited by Dr. J. V. Shoemaker, Philadelphia, p. 228, editorial. Dr. W. Goodell of the same city uses, however, the term "weed" in a more restricted sense, as appears from these words of his: "A trouble sometimes met with is termed 'weed,' it occurs about the tenth day, and does not depend upon the existence of chapped or irritated nipples. The symptoms are headache, high temperature, and a tender breast, which becomes swelled and painful; it is flushed and purple, but not glistening; it is not caked. If quinia is given largely, with morphia to subdue pain, it soon disappears" (*Amer. Journ. Obstet.*, 1881, vol. xiv. p. 138). The dictionaries of the English language I have examined do not contain the word in the sense of a disease.

who do not attempt to nurse, for in these the secretion of milk is never well established. As a rule, it is carefully combated by the use of drugs and bandages. On the other hand, mastitis is never more common than in women who begin to nurse, and from some cause or other discontinue to do so after the function is well established.

A few years ago the theory was promulgated that the inflammation of the breast was due to an infection taking place through the nipples.¹ The infecting substances were supposed to come from the lochial discharge, mycotic and ulcerative affections of the buccal cavity of the child, or unclean rags used for compresses or for washing the nipples. It was stated that, as a rule, the infection took place through erosions of the nipples, and only exceptionally through the intact apertures of the lactiferous ducts. The infection was said to be propagated through the lymphatics and interstices of the connective tissue, just as a parametritis originates from infected wounds of the cervix uteri.

This theory was soon corroborated from the side of the bacteriologists. Bumm² found in the matter taken from the depth of a mammary abscess numerous solitary samples and heaps of a diplococcus which was very like the gonococcus. He obtained a pure culture of this microbe, and produced abscesses by injecting it under the skin of several persons. He thinks that this diplococcus enters through the lactiferous ducts, progresses to the acini, gains the surrounding connective tissue, and causes an infiltration with leucocytes which softens and thus forms an abscess. Cohn³ found in mammary abscesses *Staphylococcus pyogenes aureus*, and once *Staphylococcus pyogenes albus*, and in sore nipples and in the milk of inflamed breasts a streptococcus—*i. e.* a colony of cocci linked together so as to form chains. Schlösser⁴ by the examination of numerous microscopical specimens, taken from eight cases of mastitis in the cow, came to the conclusion that in most cases mastitis is due to the immigration of schizomycetes through fissures and wounds of the nipples. These fungi cause fermentation of the milk in the lactiferous ducts, which, again, produces inflammation of the surrounding glandular tissue. Interlobular and interacinous infiltration with cells and the formation of abscesses follow. According to this author, the inflammation is always situated in the connective tissue and a true parenchymatous mastitis does not exist.

Not being versed in microbe investigations myself, I only repeat what I have found on the subject. Maybe infection by means of micro-organisms plays an important part in the production of mastitis, but in my opinion the other factor, the stasis of the milk, is of no less importance.

¹ Kaltenbach : *Centralblatt für Gynäkologie*, 1883, vol. vii. pp. 65-72.

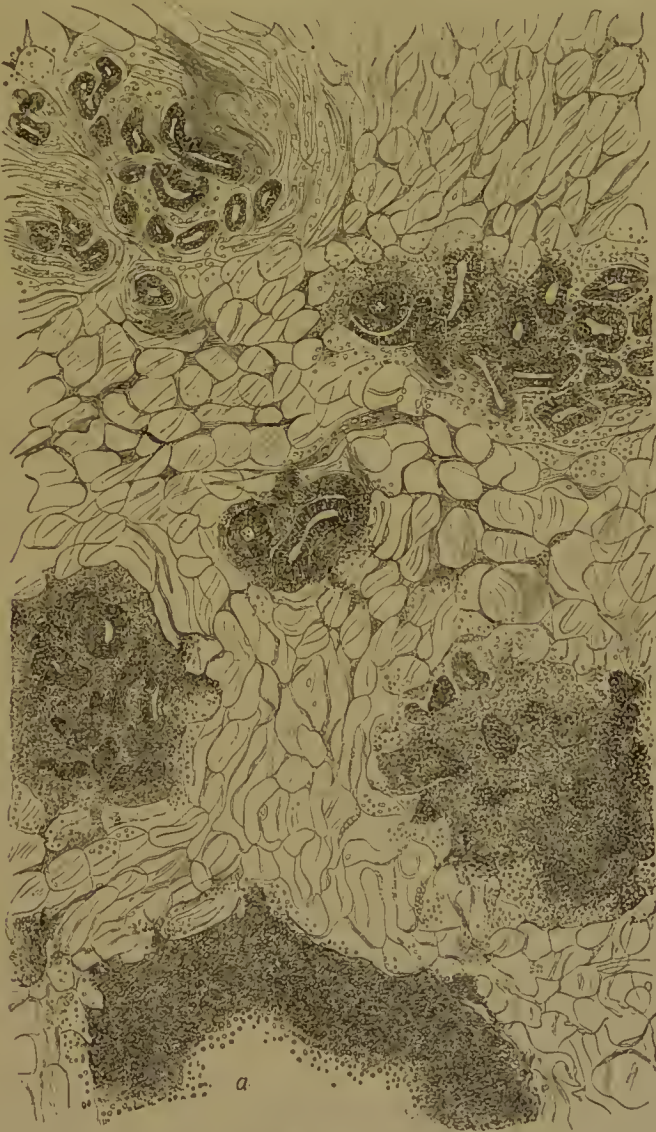
² E. Bumm : *Centralblatt für Gynäk.*, 1885, vol. ix. p. 36.

³ Cohn : *Centralblatt f. Gynäk.*, 1885, vol. ix. p. 236.

⁴ Schlösser : *Ibid.*, vol. ix. p. 30.

Kaltenbach's and Billroth's supposition, that the disease should follow the lymphatics from the nipple to the periphery, as in a case of parametritis following laceration of the cervix, leaves out of consideration the important fact that, as we have seen above, according to Sappey,

FIG. 101.



Puerperal Mastitis forming Abscess (Billroth): *a*, group of acini melted to pus.

the highest authority on the anatomy of the lymphatic system, the course of these vessels in the breast is from the base and circumference of the gland toward the nipple. It is therefore very unlikely that the infection should take place in a direction opposite to that of the current of the lymph. In consequence of a sore on a finger we get lymphan-

gitis extending up to the axillary glands, but inflamed axillary glands do not produce inflammation of the fingers.

If microbes cause the evil, they must either wander through the meshes of the network formed by the connective tissue or follow the lactiferous ducts. That the latter is the common way seems to be proved by the investigations of Schlösser on the cow, and by the specimen described by Billroth (Fig. 101), in which all acini are more or less surrounded, in some places even entirely covered, by an infiltration with small round inflammatory cells. The cellular tissue between the acini is enormously developed, but entirely free from infiltration with inflammatory cells, except in the immediate neighborhood of the acini. It is not known how long the patient from whom the specimen was taken lived after confinement nor how long she nursed her child, but it is evident that the secretion had ceased long ago.

If the microbes enter the lactiferous ducts and cause fermentation of the milk, and secondarily inflammation of the connective tissue, it is evident that this process is favored by the stagnation of the milk in the ducts and is counteracted by its removal.

Our experience in the Maternity Hospital coincides entirely with this latter view. We have practically no mammary abscesses at all. For years I have only seen one there, and that was in a scrofulous little person who on her neck bore large cicatrices from suppurating glands in her childhood—a patient upon whom I performed Cæsarean section.¹ Now we will see later that all our treatment consists in the application of tannic acid to sore nipples, an even compression of the breasts, their depletion by sucking babies or by the fingers of the nurse, and occasionally an ice-bag. If that treatment can prevent the formation of mammary abscesses, the infection cannot be a very dangerous one, and the *corpus delicti* must be found in the lactiferous ducts.

I am still more inclined to lay the greatest stress on the stasis of the milk when I compare my hospital practice with my private practice. While I am free from mammary abscesses in the former, I cannot totally avoid them in the latter. Now, I take exactly the same precautions as to antiseptics in both kinds of practice, and I treat the breasts in the same way; but private nurses, even if trained in the Maternity Hospital, do not and cannot judge with the experience of our excellent head-nurse, Miss Marion Murphy, when to let the child nurse and when to milk the breast out; nor can they do the latter with such a degree of perfection as their teacher. This less perfect depletion of the breasts is, in my opinion, the only reason why I cannot obtain as good results as to mammary complications in my private as in my public practice.

¹ Garrigues: "The Improved Cæsarean Section," *Amer. Journ. Med. Sci.*, May, 1888, pp. 439-456.

Whether mastitis is sometimes secondary to pyæmia originating in puerperal uterine phlebitis, or not, is hard to ascertain. Scharlau has published a case by which he tries to show it. Winekel has only seen one case; Hugenberger in the large epidemics of St. Petersburg none.¹ But since we have seen other glands secondarily affected in uterine phlebitis, such as the liver, the spleen, the tonsils, the parotid gland, and the thyroid body, it is not unlikely that a similar localization may take place in the mammary gland.

SYMPTOMS.—Whichever the variety of mastitis may be, the patient shows the common symptoms of an inflammation. The process begins with a chill or chilly sensations, followed by the sensation of heat; the temperature may rise to 104° Fahr.; the pulse is accelerated; the patient has headache, no appetite, but great thirst, and feels weak. The breast is painful, tender, swollen, red, and hot, but in these respects the different varieties differ somewhat.

1. The *subcutaneous variety* may, like cellulitis in other parts of the body, be circumscribed or diffuse. In the circumscribed form the skin over the inflamed tissue reddens rapidly; one or more points become soon prominent, and fluctuation becomes distinct at an early date. In order to feel it, it is best to fix the breast against the chest with the hollow of one hand and examine the swelling with the other hand and some of the fingers of the first, or to compress the breast from side to side with one hand and press with the index of the other on the prominent point.

The diffuse form has not received much attention, but is a very dangerous disease. As a rule, it begins as erysipelas, and extends from the skin inward to the subcutaneous tissue. If left to itself, it may break through the skin in many points; large shreds of dead connective tissue soaked in pus may be pulled out; and, finally, the whole mammary gland may appear as dissected at the bottom of the ulceration.

2. The *glandular variety* is by far the most frequent. When the opposite has been stated it is probably due to the circumstance that the

FIG. 102.



C.E. cuboidal epithelial cells; F, fat-globules stained black with osmic acid, and seen both in the cells and in the central cavity of the acini; C.V., connective-tissue frame with blood-vessels. Magnified 600 diameters (C. Heitzmann).

¹ Winekel: *Wochenbett Krankheiten*, 2d ed., Berlin, 1869, p. 391.

glandular abscess as a rule implicates the subcutaneous connective tissue and the skin in order to break on the surface of the body.

As to the anatomy and physiological development at different ages, and especially during pregnancy and lactation, the reader is referred to the *System of Gynecology*, Vol. II. pp. 335–338, as well as to the *System of Obstetrics*, Vol. I. pp. 342 and 524–526. Here I shall only add one of the excellent figures from C. Heitzmann's work on microscopical anatomy (Fig. 102.) It shows how the acini are lined with cuboidal epithelium, and at the beginning of lactation exhibit numerous fat-granules, both within the epithelial cells and in the central cavity of the acini. In full lactation the lobules and the acini therein assume the largest size; the epithelial cells are scarcely perceptible, for most of them are transformed to fat, and upon being treated with turpentine usually show the frame of cement-substance, the nuclei, and numerous vacuoles.¹ This corresponds with the investigations of Billroth, Schlösser,² and others, according to which the epithelial ele-

FIG. 103.



Lobules of Mammary Gland of a Puerpera, artificially injected. Magnified 70 diameters (Langer).

ment takes no part in the inflammation of the mammary gland. Even in the glandular variety we have to deal with an inflammation of the connective tissue, and a parenchymatous mastitis does not exist.

¹ C. Heitzmann: *Microscopical Morphology of the Animal Body in Health and Disease*, New York, 1883, p. 579.

² Billroth: *Loc. cit.*, p. 17; Schlösser: *Loc. cit.*, p. 30.

The great development of the lobules during lactation is well represented in Fig. 103. A good idea of the composition of the breast of a nursing woman may be derived from Fig. 104, and by combining this with Billroth's figure (p. 387) we can readily imagine how a glandular abscess is formed in different foci that gradually communicate and form an abscess.

In most cases the inflammation begins just outside of the acini, but it may be propagated to the gland from the subcutaneous or the subglandular variety. One or more hard, tender, round nodules or swollen tender lactiferous ducts are felt. The skin is at first normal, but becomes later red and sometimes cedematous. If suppuration supervenes, the hard mass softens in the centre, and slowly the softness extends in all directions. Such an abscess takes from one to three weeks or more to form. Often one abscess is developed after the other. Velpeau¹

FIG. 104.



Dissection of the Lower Half of the Breast during lactation (Luschka).

has seen fifty-two in one breast. In such cases the process may extend over many months. From the gland the inflammation may invade the subglandular or the subcutaneous tissue.

The inflammation of the gland begins most commonly in the second half of the first month after delivery, but may occur at any time, and becomes nearly as frequent after the tenth month as during the first;² which latter circumstance is probably due to the deteriorated condition of the milk at a period so remote from the birth of the child, and

¹ Velpeau : *Loc. cit.*, p. 129.

² Nunn, quoted by Winckel : *Loc. cit.*, p. 390.

is one sign among others that lactation ought not to be kept up so long.

As a rule, the PROGNOSIS is good as to life but in protracted cases with a long series of abscesses nearly the whole gland may be destroyed. Fatal hemorrhage is said to have occurred from erosion of vessels.¹ Mastitis may be the origin of septicæmia and death. Sometimes induration and fistulæ remain as sequels. Finally, the traction caused by old cicatrices predisposes to the recurrence of mastitis after following child-births. Sometimes abscesses are found to contain stinking pus and gas; which is attributed to the neighborhood of the lungs or the origin in the lactiferous ducts (Velpeau).

Apart from true inflammation, there is often found a *congestion* of the mammary gland, due to retention of milk. It is characterized by a swelling of the whole gland or some lobes of it. The breast is fastened immovably to the chest, hard, and knotty. The skin may be paler than normal or have a slight red or bluish tinge. This condition gives rise to pain, and may be accompanied by moderate fever, but shows in other women no reaction on the general system. The most frequent causes are exposure to cold, and, next to that, a too abundant secretion. This condition may disappear from one day to the other, but it may also change into mastitis.

3. *Subglandular mastitis*, like the subcutaneous variety, develops rapidly: in from two to five days it commonly reaches the greatest intensity. The pain is deep-seated; pressure on the skin is not painful; there are no swollen nodules; the skin is only slightly red; and the whole breast appears lifted up from the thorax. This variety ends almost invariably in suppuration, and points outward and downward from the breast. I have seen a case in which an overlooked subglandular abscess perforated the wall of the chest, causing fatal pleurisy. It may also produce diffuse cellulitis of the abdomen, the axilla, and the neck, and corrode bones and cartilages.

The fluctuation is often hard to detect, and it may be necessary to ascertain the presence of pus by means of a hypodermic syringe.

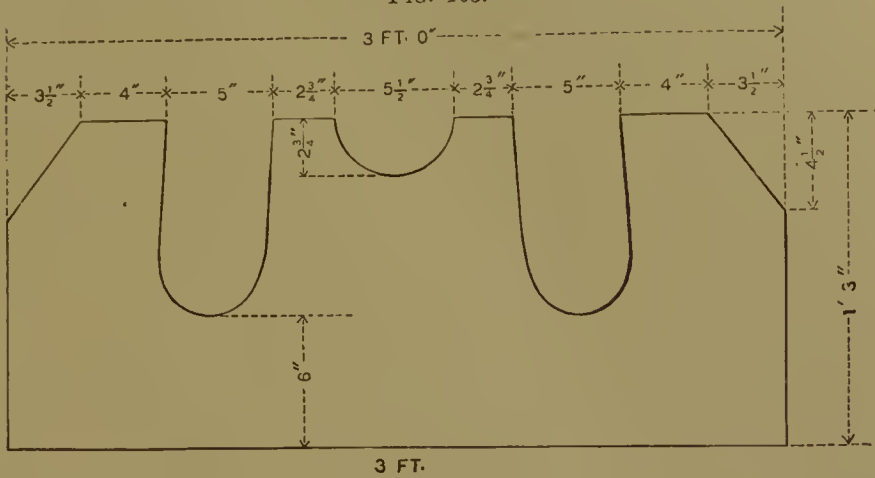
Sometimes an abscess behind the gland communicates with one in front of it through a canal in the glandular tissue, so as to form a cavity of the shape of a collar-button (*abscess en bouton de chemise* of French authors).

TREATMENT.—The treatment of mastitis is prophylactic and curative. To the prophylaxis belongs the care of the nipples during the latter months of pregnancy, and the treatment of the slightest excoriation of them during lactation, as described in speaking of sore nipples. But besides these measures, directed to the nipples, others are applied to the breasts themselves. The day they begin to fill, say about three or four

¹ Jacobus: *Amer. Journ. Obst.*, 1883, vol. xvi, p. 1259.

days after delivery, the chest of *every* patient is covered with a kind of jacket (Fig. 105) which, in all its simplicity, is the most perfect bandage

FIG. 105.



Miss Murphy's Breast-binder.

for the breasts I know of. I may praise it so much more freely as it is not my invention, although I have been indirectly instrumental in producing it. When I became connected with the Maternity Hospital mammary abscesses were very frequent occurrences. The routine treatment in the hospital at that time was to paint sore nipples with compound tincture of benzoin; empty overfilled breasts with pumps composed of a glass bell covering the nipple and a rubber ball to produce a vacuum in the bell; rub and knead caked breasts in a very active way; and apply linseed-meal poultices to mammary abscesses both before and after incision.

On the 1st of October, 1882, I introduced a radical change in this whole treatment, part of which was to apply an even compression to over-distended and caked breasts, instead of rubbing, kneading, and pumping. This was simply done with a piece of muslin that from the back went round both mammae, and was pinned tightly in front and lifted up by means of shoulder-straps. In the course of time this plan has undergone an evolution which, so far as I have been able to find out, is exclusively due to our excellent head-nurse, Miss Marion Murphy. The bandage itself, with its shoulder-straps, has grown to form a kind of jacket that surrounds the whole chest without forming a fold, gives a perfectly even support to the breasts, and allows to exercise any desired degree of compression. In the hospital we have a large number of these jackets ready made and hemmed. In private practice I improvise them by taking half a yard of strong unbleached muslin one yard wide, double it up, and cut out holes for the neck and the arms.

The other improvement is in the use of this bandage. Instead of being only used when inflammation or congestion was present, it is now used on all patients, without exception, from the time the breasts begin to fill until the patients are removed to the convalescent ward; that is, from the third or fourth day until the ninth. It is pinned from below upward, the patient herself helping to bring the breasts as high upward and inward as they will go, and a piece of wadding being inserted between the two, so as to have a corresponding degree of pressure over the inner parts of them. Last of all, the shoulder-flaps are pinned together. In normal cases the binder is put on in such a way as just to give support, and is opened halfway down every time the child shall nurse.

If the child is dead and the breasts are to be dried up, they are first covered with a circular piece of lint soaked in atropin-glycerin (R. *Atropinæ sulphat.*, gr. j; *glycerinæ*, ʒj); then comes a thick layer of cotton batting, and the jacket is fastened as tightly as possible. This dressing often remains untouched for a whole week, except that the tightening is gradually increased when the breasts become smaller. At the same time the patient is given a saline aperient.

In nursing women the breasts are kept empty by one or more babies, unless sore nipples necessitate a temporary discontinuance of nursing. Then the nurse milks the breasts out in the way described above.

This treatment is so effective that we have no mammary abscesses at all. During several years I have only had one case in my service, and that was in a scrofulous subject with particular tendency to glandular abscesses, as mentioned above. Nay, even the earlier stage of mastitis has become exceedingly rare. In mild cases we do nothing except to keep the breast empty and compressed. If there are swelling, redness, pain, and fever, an ice-bag is applied to the sick part, outside of the binder, and held in place by a separate strip of muslin round the chest.

The principle of treating inflamed breasts by means of compression is an old one, and has been tried in many ways—by roller or triangular bandages, plaster strapping, bandages with plaster of Paris or paste, a rubber bag filled more or less with air or water fastened to the breasts by means of a non-elastic cover, and straps encircling the chest.¹ Salugowski has described² what he calls a contra-mastitis bandage, but the description is not clear, and the bandage cannot possibly exercise so even a pressure as ours, as traction is only practised in one direction. It is impossible to make the roller bandage hold. Triangular bandages give a less even compression. Plaster strips round the whole body iteli, may cause eczema, erysipelas, or excoriation, are trouble-

¹ Clooten and Chassigny of Lyons: *Centralbl. für Gynäk.*, 1879, vol. iii. p. 115.

² *Centralbl. für Gynäk.*, 1886, vol. x. p. 400.

some to apply, and cause pain when removed. Plaster of Paris and similar congealing or hardening substances form a very uncomfortable entirass: soon they become too loose, and the outflowing milk soaks the wadding under them. Our bandage has the advantage over all of being simple, cleanly, comfortable, and adaptable to all cases and circumstances.

A question of great importance, and one often difficult to decide, is whether the child shall nurse or not, and whether the nursing shall be only temporarily interrupted or discontinued for good. When the nipples are badly excoriated it is better, in the interest of the mother, to substitute milking and compression for nursing for a few days. If they are in a good condition, and the breasts are threatened, the more the child nurses the better. If there is pus formed in a place in open connection with the lactiferous ducts, lactation must be discontinued in order to prevent the child from swallowing the pus together with the milk. When the abscess is healed and the hardness has disappeared, lactation may be resumed in strong individuals, but must be closely watched. On the reappearance of pain, tenderness, or swelling it ought to be instantly given up.

I may briefly refer to other methods of preventing the formation of mammary abscesses. The solid extract of *phytolacca* is spread on a cloth and kept applied to the breast which is the seat of inflammation, and the fluid extract is given internally (℞xx, t. i. d.).

Quinine is much praised. Others recommend fomentations of hot vinegar or ointments of tobacco and camphor. The iodide-of-lead and iodide-of-potassium ointment have seemed to me to work well in some cases. To all these there are at least no serious objections. Not so with bloodletting, local or general, or blistering. Venesection entails an unnecessary waste of strength. Leeches leave disfiguring cicatrices that never disappear. Blisters are painful, irritate the nerves, disturb sleep, and may even leave a mark on the delicate skin of an organ the beauty of which is dear to most women. Blue ointment, although effective as a resolvent, is liable to cause salivation, and ought not to be used when the same end can be attained in a better and safer way by compression and ice.

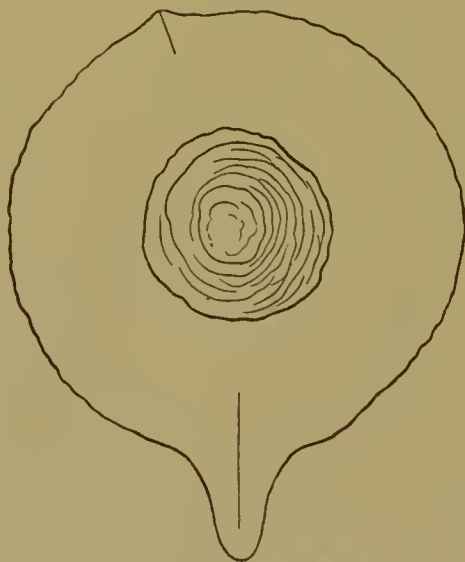
If suppuration is unavoidable, it is better to hasten it by means of a warm linseed-meal poultice. When the abscess is formed, it should be opened, but as to the proper time for doing so there is a difference between the different kinds of abscesses. While the subcutaneous and the subglandular variety ought to be opened as soon as detected, it is better to let the glandular variety have time to approach the surface.

The subcutaneous variety is, as a rule, small, and one moderately long incision is all that is necessary to empty it. On account of the

tension of the skin over the gland it will gape less and form a less visible cicatrice if made in the direction of a radius from the nipple to the circumference.

If the abscess is situated partly within and partly without the areola, the incision ought either to be made entirely on the areola or entirely outside of it. The reason of this is that the pigmentation is apt to follow

FIG. 106.



Pigment of the Areola following incisions (Richardson).

the incision, and thus a permanent irregularity in the extension of the colored part of the breast may be left as shown in Fig. 106.¹

The subglandular abscess is opened where it points at the circumference, as a rule outward and downward. An incision an inch or more in length must be made parallel to the circumference of the gland, and if no counter-opening is deemed necessary a soft-rubber drainage-tube should be pushed into the depth of the cavity formed by the abscess. A small safety-pin is pushed through the end of the tube, so as to prevent it from being drawn too far in, and a little pad of cotton, lint, or gauze is placed under the pin in order to protect the skin from pressure.

The glandular variety, as a rule, requires two or three openings in order to ensure good drainage, but they need not be more than half an inch long.

In order to avoid the lactiferous ducts they ought to be made in the direction of a radius from the nipple to the circumference. From the first opening a probe is carried as far as possible through the abscess, and a new incision is made by cutting down on the end of the probe, which is left in place to serve as a guide in introducing drains.

¹ W. L. Richardson: *Trans. Am. Gyn. Soc.*, 1876, vol. i. p. 165.

The best drain is a bundle of horse-hair, which for this purpose is washed with soap and water and disinfected with bichloride of mercury, creolin, or carbolic acid. The bundle is pulled through from one opening to the other by means of a long blunt needle with a large eye, and tied loosely over the breast. If horse-hair is not to be obtained, silk may be substituted. Soft-rubber drainage-tubes may also be used, but they cause more pain to insert if it is done without an anæsthetic. The drains are left in as long as there is any discharge. If there is only one opening, it is best to shorten the tube gradually.

Before opening the abscess the skin is washed with soap and water and an antiseptic fluid. The instruments are kept in a solution of carbolic acid, and after opening the abscess it is washed out with a similar solution or creolin (2 per cent.).

Finally, the breast is covered with large pledgets of absorbent cotton or prepared gauze wrung out of the disinfectant fluid. Outside of them comes a layer of oil-silk, oil-muslin, or gutta-percha tissue, and at last the breast-binder, sufficiently tightened to keep up a moderate pressure. The dressing is changed once a day, and at the same time the tubes and cavity are cleansed by injecting a little antiseptic fluid. Tonic remedies, especially quinine and iron, are given internally. By this treatment even a large abscess heals in a week or ten days.

Some women are so averse to the use of the knife that it may be hard to obtain their permission to have recourse to it. The subcutaneous, and especially the subglandular, variety of abscess ought to be opened without compromise, as there is real danger of their spreading far out or penetrating to deeper parts. As to abscesses situated in the gland itself, it is perhaps not so absolutely necessary to open them, but the patient ought to be made to understand that the process, if left to itself, is much longer, that the abscess acquires unnecessarily large dimensions, that more of the gland is destroyed, that there is more danger of its spreading to the subcutaneous or subglandular tissue, and—what will perhaps weigh more with her than any other consideration—that the scar will be more conspicuous.

The pain of the incision may be much lessened by the previous injection of cocaine, whereas the use of Richardson's ether spray has not seemed to me to give any considerable relief. As the necessary procedures are often quite painful, there may be indication for the induction of general anæsthesia.

In old, neglected cases there may be deeply-situated abscesses which cannot be reached except through a considerable mass of glandular tissue, an incision through which might cause dangerous hemorrhage. Under these circumstances the best treatment is to make an incision through the skin, the subcutaneous fat, and the fascia. When the gland is exposed a pointed director is thrust into the abscess, and a slender pair

of forceps is pushed along the groove of the director until it enters the cavity of the abscess. Then the blades are forcibly separated, so as to give exit to the pus, and a drainage-tube is introduced between the blades.

Congestion of the mammary gland is treated by emptying it and applying even compression in the way described.

If hard nodules remain after mastitis, they are treated with resolvent ointments, such as ung. hydrargyri or ung. potass. iodidi. If the child is weaned, the iodide of potash may be administered internally at the same time. The galvanic current has likewise proved beneficial.

Fistulæ will be considered separately.

COLD OR CHRONIC ABSCESS OF THE BREASTS.

Besides the common acute abscesses described on the preceding pages, sometimes chronic or so-called cold abscesses are found in the breasts in connection with lactation. They are commonly subglandular. Sometimes they begin like an acute abscess, but the pain soon subsides, and the swelling increases very slowly during three weeks to two months. Sometimes pain is absent altogether. Such abscesses may be found in otherwise healthy women without scrofulous or tuberculous diathesis.

TREATMENT.—If the abscess is large, several small incisions and drainage are the best treatment. If they are small, they are laid open from end to end. In both cases the local use of tincture of iodine promotes their healing. Compression and dressing are used as for acute abscesses.

SWELLING AND MILK RETENTION IN THE AXILLA.

In a certain number of cases I have seen a swelling appear in both axillæ of puerperal women which closely simulates an abscess, but is caused by the formation and retention of milk in accessory mammary tissue placed in this locality. These swellings are painful, tender to the touch, covered with normal or pink skin, and often divided in two parts by a sulcus. They may show a distinct fluctuation, and the first time I observed these swellings I came very near plunging a bistoury into them; but by means of a hypodermic syringe I satisfied myself that they contained only pure milk. In spite of the most careful palpation, I have not been able to feel any connection between them and the mammary gland.

When treated with a thick layer of compound iodine ointment they disappear in a few days. I have never seen any suppurate.

MASTITIS OF THE NEWBORN.

It is not rare to see the mammary glands of newborn children, male as well as female, become hard, tender, and swollen a few days after the birth of the child. A white fluid can be pressed out of them, which chemically and microscopically is like colostrum.¹ As a rule, this swelling is easily scattered, but sometimes suppuration intervenes, and the pus may then perforate the capsule, spread under the skin, and cause considerable destruction of the connective tissue. Under these circumstances the inflammation may be accompanied by high fever and great prostration, and may even end fatally.

TREATMENT.—As a rule, a linseed-meal poultice covered with oil-silk and a bandage round the chest produces resorption in a few days. If pus is formed, the abscess should be opened with a lancet, washed out, and dressed with carbolyzed water or creolin (1 per cent.). If there is diffuse cellulitis, several incisions, drainage, and removal of dead connective tissue may be necessary. At the same time, the patient should have a teaspoonful of a mixture of one part of brandy with three parts of water and a little sugar every one or two hours, and one grain of quinine three times a day.

FISTULÆ OF THE BREASTS.

There are two kinds of fistulæ of the breasts: one is simply a remnant of an abscess which has not closed, and is mostly found in the gland or behind it, rarely under the skin. The other is a milk fistula, a fistulous tract leading from the skin to a lactiferous duct. These may likewise have originated as a common abscess which has corroded a lactiferous duct, but they may also result from a wound by which such a duct was severed, which wound is kept open by the continual flow of milk through the artificial aperture. The fluid that comes from such a fistula may be pure milk or milk more or less mixed with pus. Such old fistulous tracts may constitute a serious drain on the constitution and cause tuberculosis of the lungs.

TREATMENT.—If the patient nurses, she should, if possible, wean the child. Sometimes compression will cause the closure of the fistula; in other cases this is obtained by means of astringent and irritant injections, especially tincture of iodine undiluted or nitrate of silver (2 per cent.), used in small quantities twice a week, or carbolic acid (2 per cent.), used daily in large quantity. Jacobs² praises Villate's solution (R. Sulphate of copper, sulphate of lead, *āā*. 15 parts; sol. subacetate

¹ Filatow: *Centralbl. f. Gynäk*, 1879, vol. iii. p. 374; Opitz: *Ibid.*, 1882, vol. vi. p. 170.

² *Loc. cit.*, p. 1266.

of lead 30 parts; vinegar 200 parts¹), mixed with two parts of water, or still more Labarraque's solution (Liq. sodæ chlorinatæ, U. S.), one part to eight or ten of water, used two or three times a day. In desperate cases it may become necessary to split the whole breast, or at least to make more or less large incisions combined with curetting by means of Simon's sharp scoop.

¹ Bartholow: *Materia Medica*, 6th ed., 1888, p. 302.

THE ETIOLOGY OF PUERPERAL FEVER.

BY HAROLD C. ERNST, A. M., M. D.,

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IN considering the cause of such a disease as "puerperal fever," so called, it is utterly impossible at the present day to get a proper grasp of its meaning and true nature if all the recent investigations into the nature of infectious diseases are not considered at the same time.

The problem before us is to study and to understand, as far as is possible, what is the cause and nature of those acute febrile and inflammatory processes following childbirth and occasionally coincident with it.

Are these changes—more often seen in places where there are collections of parturient women, but not by any means confined to such localities—are these changes due to a morbid principle generated within the victim herself, or does the virus come from without? And how is it, if the first be true, that some women are affected and others not? If the second hypothesis be the right one, what are the circumstances governing the entrance and distribution of the virus into the human body, and what is the nature of that virus?

In order to obtain a more complete understanding of the ideas to be expressed in this paper, a summary of the position it is desired to support will be useful, accompanied by a discussion of the various theories in regard to the processes under consideration that have been held very generally, and are held to-day, by a certain proportion of medical practitioners.

In the light of the revelations of modern science it seems possible to make the following statements, and to support them by evidence as conclusive as can be brought to bear upon medical subjects: 1. Puerperal fever, so called, is not, contrary to the opinion so widely held at one time, more especially on the continent of Europe, a specific disease peculiar to women in the lying-in condition. It is allied to, and in fact is exactly similar to, any other of the septicæmic or pyæmic conditions with which medical men have to deal, and which arise more commonly in connection with surgical affections, and are sometimes said to occur "idiopathically." 2. The disease is not in any sense "specific." It is due to the activity of the lower forms of life included under the

general head of "micro-organisms;" and there are a number of these micro-organisms which, introduced into the body under favorable conditions, may give rise to symptoms to be classed under the general head we are considering. 3. The cause of these symptoms is never developed in the body of the affected woman. The normal course is recovery without disturbance of the animal economy, and any variation from this course must be ascribed to the introduction of some powerful disturbing influence from without. 4. It does not necessarily require the growth of micro-organisms within the body to produce this result, although this is almost invariably the case; but the introduction of the products of this growth—the ptomaines or the leucomaines—may produce the changes to be observed, although these products do not and cannot occur without the previous growth of the organisms which give rise to them; so that the symptoms may be due to a double cause: the growth of the bacteria and the overwhelming of the system by their numbers, or the toxic effect of the alkaloids produced in the course of their growth; and these two influences may act independently or together. 5. As a corollary it follows that if the morbid principle be kept out of the body, no disturbing reaction will occur; that the channel of entrance is most commonly through the genital tract; and that the carrying agent is unquestionably very commonly the infected hands or instruments, introduced wantonly or of necessity into the vagina or uterus at a most receptive stage of their existence. There is not much of the mysterious in the matter, and no necessity for supposing the intervention of an angry Providence in order to avoid the consequences of individual responsibility. The attendants are usually the ones responsible for the occurrence of the untoward symptoms.

These opinions are widely distinct from, and opposed to, those held not so very long ago by many of the most prominent obstetricians of the day; but that they are the legitimate conclusions from all the work done upon etiological science—especially in the last ten years—seems to be easy of proof. Certain things must be taken by analogy, and the analogies and proofs in this case are so numerous and convincing that doubt appears to be impossible.

Puerperal fever has been known from the earliest times of historical medicine; that is to say, the ancient authorities speak of the liability of the lying-in woman to disease and death of the nature of blood-poisoning. The real history of the disease, together with the discussion upon its nature and causes, began less than a century ago, when the occurrence of the epidemics in lying-in hospitals in England and upon the continent of Europe attracted attention to it and gave rise to the discussions which are hardly ended to-day. To the English observers is due the credit of having first come to something of a realizing

sense of the true nature of the affection, so far as its infectious properties are concerned, whilst upon the Continent, more especially in France, the possibility of its direct communication to a lying-in woman by a human agency was denied long after the accumulation of clinical facts would seem to have rendered such doubt impossible. That the nature of the affection was understood in this country half a century ago is very well shown by the vigorous and convincing paper of our own Dr. Holmes upon *The Contagiousness of Puerperal Fever*, first published in 1843. From the clinical side the arguments brought forward and the authorities quoted in this paper furnish an overwhelming mass of evidence in favor of the infectious nature of the disease, and yet it was unconvincing to some of those who should have been best in a position to see the truth. As now published,¹ the headings of this paper stand thus: "The point at issue—the affirmative: the disease known as puerperal fever is so far contagious as to be frequently carried from patient to patient by physicians and nurses."² The negative: "The result of the whole discussion will, I trust, serve not only to exalt your views of the value and dignity of our profession, but to divest your minds of the overpowering dread that you can ever become, especially to woman under the extremely interesting circumstances of gestation and parturition, the minister of evil—that you can ever convey, in any possible manner, a horrible virus so destructive in its effects and so mysterious in its operations as that attributed to puerperal fever,"³ "in the propagation of which they have no more to do than with the propagation of cholera from Jessore to San Francisco and from Mauritius to St. Petersburg."⁴ "I arrived at that certainty in the matter that I could venture to foretell what women would be affected with the disease upon hearing by what midwife they were to be delivered or by what nurse they were to be attended during their lying-in; and almost in every instance my predictions were verified."⁵ "A certain number of deaths is caused every year by the contagion of puerperal fever communicated by the nurses and the medical attendants."⁶ "Boards of health, if such exist, or without them the medical institutions of a country, should have the power of coercing or of inflicting some kind of punishment on those who recklessly go from cases of puerperal fever to parturient or puerperal females without due precautions, and who, having been shown the risk, criminally encounter it, and convey pestilence and death to the persons they are employed to aid in the most interesting and suffering period of female existence."⁷ "We

¹ *Collected Works*, 1888, Houghton, Mifflin & Co., volume of "Medical Essays."

² O. W. Holmes, 1843.

³ Prof. Hodge, 1852.

⁴ Prof. Meigs, 1854.

⁵ Gordon, 1795.

⁶ Farr in *Fifth Annual Report of Registrar-General of England*, 1843.

⁷ *Copland's Medical Dictionary*, art. "Puerperal States and Diseases," 1852.

conceive it unnecessary to go into detail to prove the contagious nature of the disease, as there are few if any American practitioners who do not believe in this doctrine."¹

This, then, was the position of things forty years ago: the majority of clinical observers insisting upon the essential infectious nature of the disease, whilst some of the most eminent teachers of the day were opposing these assertions in words to which their positions and experience would naturally lend added weight and power. So far were these gentlemen carried that they were able to see nothing in the experience of Dr. Rutter, a contemporary of theirs, and which may be found in *The Quarterly Summary of the Transactions of the College of Physicians of Philadelphia*, for May, June, and July, 1842. Here, Dr. Condie spoke of the prevalence of puerperal fever of a peculiarly insidious and malignant type: "In the practice of one gentleman, extensively engaged as an obstetrician, nearly every female he has attended in confinement during several weeks past, within the above limits (the southern section and neighboring districts), had been attacked by the fever;" and Dr. Rutter, the practitioner referred to, said that after the occurrence of a number of cases of the disease in his practice he had left the city and had remained absent for a week, but on returning, no article of clothing he then wore having been used by him before, one of the very first cases of parturition he attended was followed by an attack of the fever and terminated fatally. He cannot readily, therefore, believe in the transmission of the disease from female to female in the person or clothes of a physician. This was on May 3, 1842, and in a later letter² he speaks of his experience of the disease, now numbering nearly seventy cases, all of which have occurred within less than a twelvemonth past, and yet he could say, as quoted above, that he "cannot readily believe in the transmission of the disease from female to female in the person or clothes of a physician." To us, at this distance of time, the explanation of the occurrence in a single individual's practice of so great a number of cases seems difficult to find, although modern ideas would certainly not permit the plea of a "coincidence" to be offered. But the complete history of the circumstances of the case is not given here, and when it is known the occurrences become easy to understand.

Dr. Rutter was suffering, during all this time, from an *ozæna* acquired from a neglected pustule following inoculation upon the index finger, and unquestionably carried the source of the inoculation of his patients with him. This source being unrecognized, all the changes of clothing or absences from the city he chose to go through with would do no good whatever.

This instance is spoken of at length as being one of the most strik-

¹ Dr. Lee, in additions to article last cited.

² *Med. Exam.*, Dec. 10, 1842.

ing and celebrated, but many others are recorded where puerperal affections have followed the path of single individuals from childbed to childbed, whilst no doubt hundreds more have occurred which have never been put in print.

When the evidence that has been accumulated upon this point is summarized and reviewed, and fails to carry conviction that, clinically speaking, puerperal fever is communicable to the patient by physicians or nurses, the state of mind refusing such evidence can only be compared to that in Watson's simile: "A man might say, 'I was in the battle of Waterloo, and saw many men around me fall down and die, and it was said that they were struck down by musket-balls; but I know better than that, for I was there all the time, and so were many of my friends, and we were never hit by any musket-balls. Musket-balls, therefore, could not have been the cause of the deaths we witnessed.' And if, like contagion, they were not palpable to the senses, such a person might go on to affirm that there existed no proof of there being any such things as musket-balls."

Evidence like that given above, derived from the collection of observed and recorded facts, was all that could be offered at the time to show what the true nature and cause of puerperal fever might be. The exact methods of modern research were then unattainable: the microscope was in existence, to be sure, but its form and power were absolutely unadapted to the researches that have since been conducted by its aid.

The very idea of the activity of the micro-organisms as factors in disease was scouted by most observers, and the theory of spontaneous generation had not yet received its deathblows. The rough form of investigation—the inoculation of morbid materials into healthy animals—had been practised to a certain extent, and to experiments of this nature by Semmelweis in 1847 are owing the first real steps in the knowledge of puerperal fever and its connection with other forms of septiciæmia and pyæmia.

By using the term "rough form of investigation" it is not meant to detract from the value of such investigations or to lessen the credit to the observers who employed them. The desire is merely to emphasize the difference between the means for close observation at that time and those at the command of all scientists who choose to employ them to-day. The development of these means is of such recent date that it is hardly ten years since they were used at all, and less than five since their employment became general; and yet it is to these methods and instruments that we owe the bases of the assertions forming the theories given in this paper.

Just ten years ago the researches into the nature of the septic poison had reached such a point only that a cautious observer used such words

as these in stating his views upon the nature of puerperal fever: "As to the precise character of the septic poison, although of late much has been said about it, and there is good reason to believe that further research may throw light on this obscure subject, too little is known to justify any positive statement. With regard to the influence of the minute organisms known as bacteria this is especially the case. Heiberg has proved that they may be traced, in most cases of puerperal septicæmia, passing through the veins and lymphatics, and that they are found in various organs and pathological products; but whether they themselves form the septic matter or carry it, or whether they are mere accidental concomitants of the pyæmic process, it is impossible, in the present state of our knowledge, to state, and I therefore prefer to dwell on that part of the subject which is of clinical importance, rather than enter into speculative theories which to-morrow may prove valueless."¹ That "to-morrow"—proving the valueless weight of the importance attached to the micro-organisms as factors in the production of disease—has never come; but, on the other hand, since that time there has been almost daily evidence put forward in support of the most advanced claims at first made for the etiological properties of these minute forms of life.

The reasons for this extremely rapid advance in our knowledge of the life-history and pathological properties of the micro-organisms are not difficult of comprehension if one knows the facts, and lie in the application to scientific investigation of three means of study, first worked out and systematized, so that the scientific world might use them, by that master of close reasoning and painstaking research, Robert Koch, now of Berlin. These three means of study were: in the first place, the application of aniline dyes to histological methods. As soon as these dyes were used in commerce, it was found that they would be of value in the study of minute anatomy, for the reason that they had an especial power of deeply staining cell-nuclei and bacteria, leaving other portions of the tissue unstained, or else being easily removed from those tissues upon the employment of simple decolorizing agents. This property, possessed by most of these aniline colors, was of the greatest importance, of course, because micro-organisms are so small that, being for the most part without pigment, they are exceedingly difficult of detection unless especially stained; and a method of special staining, generally applicable, had been wanting up to the time of the introduction of these products of coal-tar distillation. This, then, was the first step—the staining of bacteria with aniline dyes. The second was of equal importance, and consisted in the successful application to the construction of the microscope of certain laws of optics, the introduction of the homogeneous immersion lens with its wide-

¹ Playfair's *Midwifery*, ed. 1878, p. 581.

angled aperture and its straight rays from the object through the immersion medium and objective to the eye, and the use of Abbé's sub-stage illuminating apparatus, this consisting of a series of lenses, flat on top, convex beneath, placed between the mirror and the object, and throwing a flood of light upon the field of vision from below. This flood of light serves to drown out the faintly-stained structure-picture almost entirely, leaving to be seen only the deeply-stained cell-nuclei and bacteria; and this result is of the greatest possible value, because it often happens, where but few bacteria are present, that they are obscured by the details and lines of the structures containing them, whereas they come at once and distinctly into view when measures are taken for drowning out the structure-picture and leaving only the color-picture of the field of vision.

These methods were applicable to the simple discovery of the presence of bacteria, if present; but much more was necessary before a knowledge of their action in regard to the processes in which they were found could be obtained, and a surer means of their study outside of the body needed to be discovered. The suggestion of such a means formed the third great step: this is due solely to Koch's genius, and consists in the methods of isolation and pure-cultivation in solid nutrient media so widely employed to-day. Not that there had not been pure-cultures obtained before; but these had all been in fluid media, and the intimate mixture and changing positions of the organisms contained in these fluid media made it utterly impossible to differentiate species unless there was a marked difference in form. This impossibility of differentiation was the reason that the term "micrococci of pus" was used so long; and the investigation of pus by the method of examination in solid culture-media is the reason for the disuse of this term, and the acquisition of the knowledge that there are so many varieties of pyogenic micrococci with very similar morphological properties, but distinctly different pathogenic powers. Therefore it is that by reason of these three advances in methods of scientific research—*aniline dyes*, *improved lenses and illumination*, and *solid culture-media*—our whole knowledge of the place of the micro-organisms in disease has become developed and assured; and with that knowledge our conception of *pyæmia* and *septicæmia* and allied processes has necessarily undergone a complete change. The place of bacteria in the production of disease is to-day unquestioned, and more especially in connection with these very processes of *septicæmia* and *pyæmia*: in regard to them there is but the one opinion, that they are essentially "bacterial" diseases, produced by the activity of these low forms of life, and the direct result of that activity occurring in the body, or of its products resulting from their growth in or out of the body.

As a necessary preliminary to the belief in the assertion that bac-

teria are the causes of the diseases in which they are found, it would be necessary to show that the human body does not, in health, contain any of the lower forms of life that are in question. This has been done again and again, and under properly conducted experiments it has always been found that the internal animal economy is absolutely free from any forms of life that the means at our command will enable us to detect. The skin and mucous membranes are at all times, in health and disease, covered with various forms of organic life that are revealed to us by staining, microscopic examination, or culture-methods, but the internal organs not.

In health the blood contains no bacteria of any kind, and the same is to be said of the liver, spleen, kidneys, muscular tissue, etc. In disease, however, the condition of things is very different, and in this case bacteria of many kinds are found in the lesions occurring in the course of the affection under consideration, and more especially and frequently in the acute febrile processes exercising a general influence over the animal economy. Here, then, is the question: In pyæmia and septicæmia are always found bacteria—are these bacteria the cause of the disease or not? The older definitions—and not so very old—of these two affections are as follows: "*Pyæmia*. Purulent contamination of the blood, producing marked depression of the vital powers, the formation of abscesses in various regions of the body, etc., constituting the *Diathesis sen infectio purulenta*—*Purulent contamination diathesis*, *Purulent infection*. It is supposed by some to be due to suppurative capillary phlebitis; by others, to coagulation of the vitiated blood in the vessels—the veins especially—or the heart, and to the inflammation and suppuration developed by the clots when detached and carried into the capillaries of other parts."¹ "*Septicæmia*. Putrid infection. A morbid condition of the blood produced by septic or putrid matters—animal poisons especially—the inhalation of foul air or septic gases. It resembles pyæmia in its symptoms: the latter may be regarded, however, as a purulent infection; septicæmia as a putrid infection."² This shows the broad distinctions and similarities between the two processes at the time of the beginning of bacteriological researches as at present conducted, and offers as clear an idea of the state of medical opinion as could well be given. The great change in the ideas held to-day is unquestionably the result of work done within fifteen years, and the special beginning was marked by the publication of Koch's work on *Wundinfektionskrankheiten*. Here the problem was first clearly stated, and the fact made patent, that these terms (septicæmia and pyæmia) cannot be held to have any significance whatever as indicating specific diseases, but that they must be considered as words used for convenience to denote clinical symptoms somewhat

¹ *Dunglison's Med. Dict.*, ed. 1874.

² *Ibid.*

allied. It is not necessary, therefore, to discard them at once and for good; but it is of great importance to remember that their meaning is only clinical, and that the symptoms indicated by them are the result of many causes acting separately or together; that is to say, that the symptoms are produced by one or more varieties of bacteria acting together or separately, and that a scientific nomenclature to-day requires that the cause of the symptoms observed in the individual case shall be called by the name of the bacterium or bacteria active in producing them. Pyæmia does not arise from the entrance of pus into the blood-veins, and septicæmia is not putrefaction of the living blood.

For a long time pyæmia was distinguished from septicæmia by the occurrence of metastatic deposits in the former and their absence in the latter. But since it has been established that even in such cases as had previously been described as septicæmia isolated microscopic metastatic deposits are not infrequently present, and that the two processes cannot be definitely separated in this way, some authors have preferred to designate as septicæmia the disease brought about by absorption of dissolved putrid poison, and to call all the other morbid processes connected with the development of microscopic organisms pyæmic processes. Birch-Hirschfeld,¹ for example, separated pyæmia from septicæmia in this way. He understood by the term "septicæmia" a disease originating in alterations of the blood, which alterations were a consequence of the absorption of the products of putrefaction. On the other hand, he defined pyæmia as a "general infection," which proceeds from the surface of wounds or from the forms of a primary suppurative inflammation probably evoked by specific organisms and different from the putrid infection. Cohnheim² also identified septicæmia with putrid infection, and attributed it to the entrance of a putrid poison in solution into the fluids of the body. Davaine adhered, on the other hand, to the older distinction between pyæmia and septicæmia, and included under the latter term all those cases in which post-mortem examination shows no metastatic deposits, although in both cases he considered the co-operation of specific organisms as proven.

In order to justify the assertion that such diseases as pyæmia and septicæmia are produced by living organisms, and not dead matter, and that these organisms are introduced from without, and do not develop *de novo* in the living tissues in which they are found, a line of reasoning and experimentation somewhat as follows is necessary:

1. Bacteria must be proved not to occur in the healthy animal tissue.

2. The methods of introduction of the micro-organism into the body

¹ *Lehrbuch der Pathologischen Anatomie*, Leipzig, 1876, p. 1224.

² *Vorlesungen über Pathologie*, Berlin, 1877, S. 469.

must be shown, and their etiological relationship to the processes accompanying their presence must be proved.

3. These micro-organisms must be proved not to be capable of self-production; that is to say, that the old doctrine of *omnis cellula e cellula* must be reaffirmed, and supported by evidence obtained from the modern exact methods of research.

1. The first question is settled by an enormous number of experiments; and it is known that in health no micro-organisms are found in the tissues of the animal body. Observation of blood and organs, every known precaution against the accidental introduction of bacteria being taken, have shown repeatedly the truth of this fact; so that its acceptance is perfectly justifiable upon the evidence presented.

2. Therefore it is but a truism to say that, the presence of bacteria being coincident with disease, they must have some relation to it, and that that relationship may be an active or a passive one. And this is, of course, the especial point upon which so much difference of opinion has been expressed, as to whether this relationship is one of cause or simply one of accompaniment of the pathological process. In the first place, what are the probabilities? All clinical experience, properly interpreted, shows, as has been stated before, that certain affections classed under the heads of pyæmia and septicæmia are infectious; that is, that they may be, and are, communicated from patient to patient. Now, the nature of the cause of these affections must be one of two: it must be either dead, incapable of reproduction ("chemical"), or it must be living; it must be capable of increase in some way of self-reproduction; and we can form no conception of anything that can do this sort of thing except those lowest forms of life known as micro-organisms or something still higher in the scale of animated nature. That the poison is not chemical in the first instance we are justified in concluding by analogy. All we know of pure chemical action shows this. A toxic dose of arsenic is toxic for the individual alone; the same effect can only be produced with the same poison by the extraction of the entire quantity from the body of the person to whom it was first given. No increase of the amount over the dose first given is ever found to occur, and the division of the original dose results simply in a proportionate diminution of the amount of change produced, and never under any circumstances in an increase or equalling of the changes arising from the whole of the original amount. On the contrary, a living ferment is capable of constant and indefinite reproduction and increase, provided proper conditions for its development be present, and we are forced to the acceptance of the conclusion that this is the nature of the poison concerned in the reproduction of epidemics of disease such as those we have under consideration. If their cause were chemical simply, there would be but one case, and there an end;

but, as this limitation of the disease does not—or rather did not—usually occur, it is not possible to grant their simple chemical origin.

That the cause is something more than a chemical agent, and these diseases something besides simple chemical reactions, have been proven, however, in a much different and more forcible way than by the mere force of analogy. Experimentation has been called in by numerous and capable observers, and we are able to say to-day of suppurative and allied processes that these do not occur without the precedent activity of micro-organisms. Of these experiments only a few can be mentioned, but they will serve to show the direction and methods pursued in them all. Before our knowledge of bacteriological methods was as precise as is now the case, such experiments as those of Councilman¹ and others were considered to be conclusive. These experiments show, or seem to show, that the introduction of simple irritant substances into the animal tissues was sufficient to set up a more or less marked degree of irritation, followed by suppuration and the production of a localized or sometimes of a general purulent process. The materials used were croton oil, turpentine, and the like, and the results observed after their introduction into animals were ascribed to a specific power which they possessed, which could, and generally did, produce pus-formation when such materials came in contact with animal tissues. These experiments did seem to be conclusive at the time they were published, but with our more recent and intimate knowledge of bacteria their fallacies are easily to be perceived, and are seen to lie very largely in the imperfect methods taken to prevent the activity of bacteria, and the fact that these latter were not sought in the lesions produced by means which would lead to their detection if present. It is not surprising, therefore, to read the results of Klemperer in his admirable article upon this subject.² Thinking, and with apparently good reason, that the results of other observers might be due, in part at least, to the imperfect sterilization of the skin of the animals experimented upon, this author made all his inoculations at a point which had been just previously seared with a hot iron, and again used the actual cautery at the point of inoculation after the operation was over. Of course the syringe and material employed were thoroughly sterilized in the usual way. Experiments were made in large numbers with acids, alkalies, cantharides, mustard oil, petroleum, and other irritating materials, and upon rabbits, guinea-pigs, and mice. Pus-formation never occurred: at the most, the only sign of any local or general disturbance was a moderate localized serous effusion. After the use of croton oil or mercurial injections there occurred in some cases a firm necrotic (diphtheroid) infiltration—Weigert's "acute coagulation necrosis." In only three of

¹ *Virchow's Archiv*, Bd. xcii. p. 217.

² *Zeit. f. klin. Med.*, Bd. x. S. 198, and *Fort. d. Med.*, 1886, S. 34.

a large number of cases did suppuration occur, and in all of these cases micrococci were found in the pus, and the observations were therefore considered imperfect. The observer concludes that the strongest chemical cannot produce suppuration without the presence of bacteria; and his results certainly seem to support this view. He found also a micrococcus which, under ordinary circumstances, would produce no suppuration upon inoculation into animals, but which would set up a flow of pus if an irritation were produced, such as would result after the introduction of acrid materials into the tissues. A most interesting set of experiments were conducted by Scheuerlein,¹ who also investigated this question, and came to the same conclusion as Klemperer, that no suppuration will occur without the presence of micro-organisms. His method was a little different and more exacting, and the results are therefore more interesting and important. He placed from one to four drops of the irritating substance in capillary tubes. These tubes were then sealed, sterilized, and introduced under the skin of rabbits with all possible germicidal precautions. When the incision made for their introduction was thoroughly healed, taking six days as a rule, the tubes were broken under the skin, and the animals were killed in from four to eight days. Thirteen irritating substances were used, such as oil of turpentine, croton oil, oil of mustard, ipecac, tartar emetic, formic acid, etc., with distilled water as a control. In only one case was suppuration observed, and bacteria were found in this one.

These experiments and others like them seem to show conclusively that no suppuration, local or general, and no general septicæmic or pyæmic results, could be obtained by the introduction of ordinary irritant substances into the animal economy—that any resemblance to a suppurative process was localized, provided bacteria were excluded, and was not true suppuration at all, as shown in Klemperer's paper. And these facts have become so firmly established that it will need careful study before the results announced by Christmas² are accepted. Before him the experiments spoken of above had of course been subjected to much criticism, and many attempts had been made to show their lack of conclusiveness. Councilman's experiments have already been referred to, and, although he asserts that he obtained small abscesses about the fragments of the glass capsules containing the irritating substances, but found no bacteria, the lack of culture-experiments in his work destroys the force of the assertion. Orthmann and Uskoff³ claimed that oil of turpentine and mercury, if injected under the skin of a dog, would produce profuse suppuration without the presence of bacteria. And Grawitz and De Bary⁴ obtained similar results, showing that corrosive

¹ *Von Langenbeck's Arch.*, Bd. xxxii. Heft 2.

² *Ann. de l'Institut Pasteur*, Sept., 1888.

³ *Virch. Arch.*, xc. 579, and *ibid.*, lxxxvi. S. 510.

⁴ *Ibid.*, cviii. S. 67.

sublimate, alcohol, acids, and alkalies cannot produce abscesses, but that the injection of strong doses of nitrate of silver or essence of turpentine under the skin of a dog does produce a purulent suppuration without the presence of bacteria. Grawitz also¹ announces experiments with cadavérine, a result of bacterial growth, which he says will produce suppuration as quickly as would the introduction of the organism that gave rise to it.

The question would seem, therefore, to be far from settled, excepting that this criticism of all these experiments should be made: that they were not conducted with all the precautions against contamination that researches in this field require, and that it is not made sufficiently plain that the so-called suppurative processes themselves were exhibitions of true pus or no, and that the pus was searched with sufficient thoroughness and by the best microscopical and cultivation methods. Therefore they were not allowed to overbalance the more positive evidence that suppuration and septicæmic processes in general are produced by the activity of the micro-organisms, and the discrepancies in the results obtained by the two sets of observers were set down to faulty methods, these faulty methods being naturally supposed to lie on the side producing the least evidence of acquaintance with and employment of the exacting details of modern research. Matters stand thus to-day, and the advocates of the bacterial origin of diseases of a suppurative, pyæmic, or septicæmic nature are not ready to accept any assertions denying such origin until all the requirements they ask of themselves to prove the presence and activity of micro-organisms have been fulfilled by those who would deny their presence. This, it is to be said, is not often done, and observers are apt to forget that whilst the assertions of skilled bacteriologists are only made after long and careful research—so long and careful that one who has not tried it knows nothing about it—on the other hand, their opponents have been permitted to make assertions and conclusive arguments from facts drawn from any source rather than that of exact knowledge. The matter stands, therefore, that the etiological rôle of the micro-organisms in the production of the processes under consideration is undisputed: that they are always a factor is denied by many, by reason of observations based upon what must be called imperfect methods. These observations have been unsupported by any trustworthy evidence—by that meaning evidence obtained under rigid bacteriological rules—until the recent appearance of the paper by Christmas spoken of above; and this, if true, may contain the solution of the difficulties, but will certainly require the confirmation of independent and competent observation before it can even be accepted as true, although the observer himself has already shown powers of accurate observation. But matters

¹ *Virchow's Archiv*, Bd. cx.

have come to such a pass in regard to bacteriological work that one must not only be on one's guard against accepting conclusions based upon insufficient evidence, but the best observers' work must receive ample confirmation before it can be fully accepted by the cautious reviewer. However, the work can speak best for itself. Christmas tried a number of irritating substances in different ways. One set of experiments consisted in the injection under the skin of one-half a cubic centimeter of such materials as essence of turpentine, mercury, petroleum, chloride of zinc in 10 per cent. solution, glycerin, and nitrate of silver in 5 per cent. solution, with a uniformly negative result, except once out of thirty experiments. In this one case, after inoculation with turpentine, there did appear a true suppuration, but cultivation-experiments showed the presence of the *Staphylococcus pyogenis aureus*; in all the other cases the substances introduced disappeared or were absorbed after varying lengths of time and in different ways. The second set of experiments was the inoculation of the same series of substances into the anterior chamber of the eye. The result, with a dose of two drops, was absolutely negative in all the cases, except with mercury. All the other substances were absorbed with varying symptoms except mercury, which, while having an energetic local action upon the eye, produced also as true a suppuration as if bacteria had been present, and yet neither the microscope nor cultivation-experiments revealed the presence of bacteria. These experiments with mercury he repeated many times, and always obtained precisely the same results; and the regular development of pus around the mercury, the slow increase in its amount, the acute inflammation of the conjunctiva, the arrest of the suppuration when the mercury is so surrounded as to lose its pyogenic action,—all seem to prove to him that the suppuration is non-bacterial in origin. Thus far, however, he seems to have obtained no very distinct or impressive results, but his work in the next class of cases (upon dogs) seems to have been more conclusive. Using the same substances—especially nitrate of silver, essence of turpentine, and mercury—he obtained very considerable suppuration. He selected the three substances mentioned, because they are the ones which have given rise to the most discussion, and his desire was to prove the chemical nature of suppuration rather than to give a complete list of all the materials which might produce it. The details of the operation are claimed to have been carried out with the greatest rigor, and complete microscopic and culture examinations were made. The nitrate of silver and essence of turpentine were carried to ebullition before being used, and the mercury was raised to 150° Cent. All of these substances produced true abscesses, but there were no bacteria to be found; and he says that the conclusion is to be reached, therefore, "that bacteria also bring on suppuration by producing chemical alterations

under the direct or indirect influence of the substances which they produce." A pyogenic substance has been found in cultures of the *Staphylococcus pyogenis aureus*, because the bouillon in which it has been grown, after being raised to 100° Cent.—a temperature which destroys the organism—will produce subcutaneous abscesses in dogs and in the anterior chamber of the eye in rabbits, although the sterility of the bouillon after boiling, so far as the bacteria are concerned, is proven by making cultures of it in other nutrient media. By filtering a similar culture in bouillon through Chamberland's filter a liquid is obtained which produces œdema of the conjunctiva and a slight suppuration in the anterior chamber of the eye of a rabbit. Precipitating the filtered liquid with alcohol, an abundant precipitate of albuminous substances is obtained. If this precipitate be filtered out, washed thoroughly with alcohol, and then made into an aqueous solution, it will give precisely the same results as the filtered culture upon inoculation into the eye of rabbits—*i. e.* œdema of the conjunctiva, discoloration of the iris, and slight suppuration of the anterior chamber. This substance resembles the diastase of Arloing,¹ obtained in cultures of the bacillus of pleuropneumonia, but differs from that of Leber,² which he extracted with alcohol from cultures of the *Staphylococcus pyogenis aureus*. If Leber's discovery is confirmed, it shows that the bacteria of suppuration can produce several pyogenic substances, and that it is by their intervention that suppuration is produced in the tissues. Christmas concludes, then, that suppuration must be considered as an effect of the reaction of the tissues against certain chemical substances which may be produced by living organisms or by those substances of a purely chemical nature. This paper would have been much more convincing if its author had not only given us the details of his experiments, but also if he could have satisfied us that the "suppurations considérables" which he saw so frequently were anything more or more definite than the "coagulation necrosis" which has been seen more than once before, and has also been more than once mistaken for true suppuration. Under any circumstances his experiments will have to be repeated and confirmed by independent observers before they can be accepted as positive proof of his statement; and, whether they be proved or disproved, the situation of things will remain the same, and bacterial activity will still be considered necessary for the production of any general systemic symptoms; and for this reason: it has always been carefully stated that the results forming the subject of discussion in this paper were to be considered as being due to the activity of the bacteria themselves or to the products resulting from this activity. It may be true that the symptoms are the result of the ptomaines or leucomaines produced as a

¹ *Comptes Rendus*, 1888, Nos. 19 and 25.

² *Fort. d. Med.*, Bd. vi., June 15, 1888.

result of bacterial growth, and not to the bacteria themselves; but it is equally true that in the majority of cases of septicæmia or pyæmia the symptoms are of gradual occurrence: they do not appear at once and in full force, as would be the case if the cause were a chemical one pure and simple, but there is a period of beginning, increase, and a decline when the termination is not fatal, all pointing toward a constant renewal and increase and decline of the cause producing those symptoms. A constant change in the amount of the morbid material present, in other words, and this constant change in the amount present, and with it the intensity of the symptoms, vary first and foremost with the increase or decrease of the number of bacteria present, or, if it is liked better, with the amount of the chemical products present; which must be in accord with the activity of growth of these micro-organisms going on or completed at the time. So that even if it be true that suppuration is, after all, speaking scientifically, a chemical process, it does not alter the facts of the relation of bacteria to its production, for the reason that no careful observer has ever denied that there may be some intermediary between the growing bacteria and the changes produced in the medium in which they grow, or that this may very probably be found in some of the chemical compounds resulting from the retrograde metamorphosis of substances in which they flourish. Every one has realized that this retrograde metamorphosis must result in the formation of new compounds, and the nature and compositions of these new compounds are but just beginning to be studied: so new is the subject, indeed, that the very existence of what is undoubtedly an enormous and distinct class of substances, and these substances of the greatest importance in medicine, is but barely recognized by a vast majority of the physicians of to-day.

How is it proven that bacteria are connected with disease as causal factors? What is the evidence required upon such a subject in general, and in regard to the special affections under consideration? The following steps are always necessary: 1. The constant occurrence of micro-organisms in the lesions of the disease under consideration. 2. Their isolation from these lesions and observation as pure-cultures under artificial conditions outside of the body. 3. The production of similar lesions to those in which they were first found upon inoculation into animals susceptible to the disease. These are the main points: of course there are many details which are added whilst the work is being carried on, and which tend to ensure the accuracy of the whole. Have these conditions been fulfilled in regard to septicæmias and pyæmias in general, and the localized clinical affection called puerperal fever in particular? The answer is emphatically "Yes"—that it is in these very processes that our knowledge of the specific pathogenic properties of bacteria is most extensive and most accurate. The first condition has

been most thoroughly worked out, and always—in every case examined under proper conditions—there have been found micro-organisms in the individuals affected; and these micro-organisms, upon being subjected to pure-cultivation and inoculated into animals, have produced results similar to those seen in the original lesion in which they were found. Frequently more than one variety has been seen, and usually each one has been shown to have pathogenic properties of its own, although occasionally a non-pathogenic organism has been separated from processes produced by a more virulent organism growing with it. It has not been in the least possible to show that the clinical symptoms grouped under the head of pyæmia or septicæmia are always produced by the same organism. There are a large number which have been found in such affections, clinically similar, and which are yet known to possess distinct properties under cultivation and upon inoculation; so that it is no longer possible to speak of the micrococcus of pus as if there were but one, or of the septic vibrio, assuming the same condition of things.

There are a number of bacteria which will produce suppuration, as there are also a number which will produce septic intoxication; and the powers of each are not always confined to the one class of process, but may be exerted in the other, the difference at different times being due to the mode of entrance into the individual and the condition of the surroundings, as favoring or retarding their development after an entrance has been effected.

Septicæmias and pyæmias belong to that class of affections called “infectious wound-diseases:” they are the results of wounds to the integument or mucous membranes which permit of the entrance of bacteria. Wounds in this sense are not necessarily appreciable to the eye: the organisms with which we have to deal do not require a channel of entrance wide enough to be perceptible to our gross senses. Other conditions being equal, they need but a solution of continuity so small as to be with difficulty detected by the microscope, and therefore it is that “how they enter” is so often a mysterious problem; and it is because of the lack of appreciation of this fact that so many assertions are heard in regard to the impossibility of the bacteria found in a pathological process having anything to do with it as a cause, because they could not have got in from the outside.

The overwhelming testimony that they are not present in health, and that they do not create themselves, and that such pathological changes are produced by and do not go on without them, shows plainly enough, however, that they *do* enter the body at the beginning of the pathological change, although the mode of entrance is not always as clear to us as in the case of an open wound that does not do well and is followed by a general infection of the body.

“Modes of infection” have not been a subject of recent investiga-

tion: many of the present ideas in regard to miasmatic infectious disease are not new, and the science of epidemiology is much older than bacteriology, and has taught us many things; and the question arises whether from this study we have any more or better light upon the "miasm" of contagium or of "miasmatic contagium" than we had before, or whether we have any better idea of the transmission of disease from the sick to the well, or of that very active question, the one of "predisposition." And the answer is "Yes"—that the nature of infection and infectious diseases is better understood than ever, for most modern authors are agreed that it is equivalent to the entrance and activity of bacteria in the living tissue. In the absence of any other probable—it may be said of any other conceivable—hypothesis, to refuse to accept the doctrine of a *contagium vivum* as applicable to all infectious disease, because it has been demonstrated only for certain of these diseases, is about as reasonable as to reject the law *omnis cellula e cellula* because this law has not been proven for every cell or every species of cell.¹

Originally, we find that the distinction between contagium and miasm was sharply defined, and a "contagium" was considered to multiply in the diseased body and to be capable of transmission to a healthy body; "miasm," on the other hand, was thought to be produced outside of the body, not to multiply in the body, and not to be emitted from the body in such a condition as to be capable of producing infection; that is, contagium was "endogenous" and miasm was "exogenous." These ideas furnished a fairly satisfactory working hypothesis for such diseases as syphilis and the exanthemata on the one hand, and for the typically miasmatic diseases, such as malaria, on the other; but they were completely upset upon the appearance of Asiatic cholera in the early part of the century, because here was a disease that manifestly—so it seemed—arose at one time from immediate contact with other cases, and at another from an apparently miasmatic source. Therefore a new term was necessary, and to satisfy the requirements of observed facts that of "miasmatic contagious" diseases was adopted; and in this class were placed cholera, typhoid fever, yellow fever, and several other infectious diseases that could not be classed under the special heads. In regard to these diseases, the most prevalent idea—invented to explain the differences in their apparent infectiousness at different times—is that they throw off a poison which is at one time capable of reproducing the disease, and at others not. Granting that this poison is of a bacterial nature, such a variation in virulence is contrary to all our knowledge of the life-history of these organisms, and is entirely unsupported by the facts observed. It is true that under forced conditions of experimentation a certain change in pathogenic power has

¹ Welch: *Modes of Infection*.

been noted in some of these organisms, and, within certain limits, that this change can be produced at will; but no such variation has been observed either in organisms fresh from the body or in those which have been cultivated under normal conditions out of the body, even though this cultivation extends over a long time. On the contrary, observers in this line of research are inclined to ascribe especially active properties to the organisms freshly obtained from the pathological processes; and this opinion is supported by numbers of experiments, so that the apparent differences in the infectiousness of the various diseases of bacterial origin at different times are to be explained upon a different basis, if at all. And this explanation is readily found if only the modes of entrance and of elimination be considered. Thus in typhoid fever the method of elimination of the producing cause of the disease is by the intestines in the stools; and of course the chances of contamination by such means are very much smaller than in the case of such a disease as scarlet fever, in which the elimination occurs, at least in large part, from the skin, and the poison is carried so easily from person to person in the fine dust resulting from the drying and exfoliating epidermis. In the same way we must look for the explanation of the origin and transportation of such a disease as puerperal fever. Being unquestionably due to bacterial action, how are we to explain its course? The innumerable histories of numbers of cases arising in the practice of one man, the individuals being separated from each other and from other cases of the disease, and the history of the epidemics in lying-in hospitals, can be interpreted in but one way; and that is, that the poison is brought to the patient from some other case, is not eliminated unless taken away upon fingers, instruments, or utensils, and is most certainly not in any sense or degree of a miasmatic nature. And yet how little the true nature of puerperal fever is understood—even to-day by some of those who should know—is very well illustrated by an article in the *Edinburgh Medical Journal* for May, 1888, where will be found reported a case of puerperal septicæmia caused by the patient's proximity to a case of gastric cancer. At first the connection between these two is inexplicable, and it becomes even more so upon reading the additional history of the case, this simply showing a misapprehension of the facts, which are plain enough, one would think, without being twisted.

The account goes on to say that the adherent membranes were removed by the hand *in utero*, and that "the next day" a 1 : 5000 sublimate douche was given. One would suppose that, knowing the difficulties of rendering the hands aseptic, and considering the late time of the use of the douche, it would be more natural to look for the cause on the hands, rather than to seek an explanation which avoids individual responsibility, to be sure, but is not in the least degree in

accord with the facts brought together by modern science and so generally recognized to-day.

It may be said, "All this may be very true, but what is its bearing upon the special question at issue?" The answer is this: All that class of diseases called "infectious wound-diseases" are to-day known to be due to the activity of micro-organisms, this knowledge having been gained, in many cases, by rigid scientific experiments, and in others by analogies forced upon us by knowledge gained in this way. In this class of cases must be included those processes known as septicæmia and pyæmia; and—here is the special point—puerperal septicæmia, pyæmia, whatever name one may choose to give to it, is, in the first place, only a clinical separation from the general group of septicæmias or pyæmias arising from many sources, and is, in the second and most important place, essentially an "infectious wound-disease." No pathological changes have ever been noticed in cases dead of puerperal septicæmia that differ in any way from those acknowledged to be characteristic of septicæmias in general, except perhaps in situation; so that they are all alike in that respect. The clinical histories are the same, the symptoms varying in intensity in puerperal cases as they do in others, with some additional ones of course, as the process is more or less localized in the region of the uterus, so that the similarities are constant from this point of view. On the other hand, the parturient woman is most essentially in the condition of a *wounded* woman: there are invariably more or less important solutions of continuity in the genital tract, minute and imperceptible to the ordinary observation very likely, but none the less actual in their presence and danger, as offering a possible chance for the entrance of bacteria beneath the protecting shield of the mucous membrane. For a systematic description of the appearances in puerperal fever one must look into that of pyæmia and septicæmia in general; and that this idea is not new is shown by the assertion of Wilkes and Moxon, that "in proportion as fever following parturition is ascribed to simple inflammation about the uterus, in such proportion is it unnecessary to suppose the existence of any specific puerperal fever. But in a considerable division of such fevers the local inflammation is trifling or absent. The disease comes under the pathology of pyæmia; indeed, it appears that any general distinction between puerperal fever and pyæmia rests only in the relative frequency of contamination by fever poisons, which is much greater in the puerperal cases; for the rest, inspections of bodies dead of puerperal fever will offer examples of all the varieties of pyæmic accident."¹ In one form of puerperal fever, upon autopsy of those dead of metro-peritonitis soon after parturition, the uterus is found usually flabby and dilated; its walls are soft and more or less macerated, while the venous

¹ Wilkes and Moxon: *Path. Anat.*, p. 629, 1879.

sinuses are habitually filled to a greater or less extent with pus or a fibrino-puriform coagulum. The mucous membrane presents a wine-red color, and is soaked in a sanious puriform liquid, while the uterine body is pulpy and softened. At the placental site a vegetating surface is present, formed by the cotyledons of the mucous membrane. At the projecting, most prominent parts of the cotyledons are often seen small fibrinous casts. The entire placental disk is soft and infiltrated with a sanious and puriform fluid of a fetid odor, whilst often all this portion of the mucous membrane is gangrenous and of a brown-black color, from which flakes are detached upon immersion in water. At other times there is a grayish-white membrane, which becomes detached in fragments and under which the mucous tissue is reddish brown. This gangrenous or diphtheritic pseudo-membrane is sometimes extended over the entire surface of the uterine mucous membrane. Under the microscope a large number of lymphoid cells are detected in the fluid obtained by scrapings, and these cells show upon their surface or in their interior a greater or less number of pairs or chains of round bacteria. In the deeper layers of the mucous membrane and of the serous infiltrated chorion scrapings obtain a large number of lymphoid cells and large connective-tissue cells, which are swollen and fatty-degenerated. The neck of the uterus is softened, red or purple in color, and often covered with a gray pseudo-membrane, with an intensely congested tissue beneath. The same gangrenous lesions occur in places in the vagina or vulva. The venous sinuses may be empty or may contain a puriform fluid which may give place to coagulated fibrin or a softened semifluid mass, mixed with lymphoid or swollen and granular endothelial cells. The walls of the sinuses present the very characteristic appearances of an endo- and periphlebitis. The large veins are often filled with pus or fibrin, and the connective tissue of the large ligaments always contains a greater or less quantity of pus; and so much is this the case that purulent centres are usually found in the connective tissue, the lymphatics, or veins upon making successive sections of the large ligaments. The superficial lymphatic vessels of the uterus are usually filled with pus, and in all cases the peritoneum surrounding the uterus is the seat of an intense inflammation accompanied by redness, increased vascularity, the formation of fibrino-purulent false membrane upon its surface, and by a purulent infiltration of its connective tissue. Section of the ligaments through the infiltrated portions shows that when stained with methyl-violet *B.*, and then in iodine and iodide of potash (Gram's method), there are present large quantities of migratory and fixed swollen cells in the fibrinous bundles, and that the liquids and the cells present a mass of bacteria occurring in pairs (Diplococci) or in chains (Streptococci). The fibrinous false membranes, examined and stained by the same process, show between

the bundles of fibrin vast numbers of lymphoid cells covered and filled with the same chain bacteria. These are the special appearances to be found in a recent and acute case of one form of so-called puerperal fever; but a consideration of this special affection requires, as has been insisted upon, a review of all that class of cases due to the absorption of septic matter through wounds, and giving rise to the general accompaniments of fever, subdelirium, prostration, poisoning of the whole organism, and a more or less rapid fatality. For accidents of this nature arising during the puerperium are surely the results of the introduction of poisons from without, and the parturient uterus is unquestionably a wounded surface—in the sense of a lesion of continuity always, and almost always in the more usual and accepted sense of an actual tear or wound of some of the parts. That the condition of the uterus must be considered, after parturition, as bringing the patient under the head of those liable to an infectious wound-disease is perfectly evident if the state of affairs be examined.

In the production of such affections there are several conditions necessary, all of which are fulfilled in this case. There is required, first, a channel of entrance; second, a receptive condition; and, third, an active poison capable of producing results, the first two conditions being fulfilled. The channel of entrance is furnished, even in cases of normal delivery, by the temporary denudation of the placental site of its protecting membrane. This loss of the protecting power may be only temporary and of exceedingly short duration, but that it occurs in all normal parturient processes in the human race is distinctly proven by the best recent embryological researches. Actual wounds constantly occur also, even in what are called normal deliveries, by the stretching and consequent tears produced and that may occur throughout the vaginal tract—tears so small and insignificant that they produce no effect whatever of themselves, but quite large enough to present a means of entrance to such minute organisms as are bacteria. The second condition, that of receptivity, includes all of those causes that tend to lower the vital forces, even for a short time only. This lowering of the vital energy is a prerequisite to the beginning of any disease of whatever nature, and may arise from almost innumerable causes, of which physical exhaustion or mental is the most common. Now, in parturition both mental exhaustion and physical exhaustion are present always in some degree, the intensity of either varying greatly with the strength of the patient and the physical difficulty of the labor, or with the mental characteristics of the woman concerned. Here, then, are present—and unavoidably so—in every case the conditions most favorable to the entrance and activity, with their disastrous effects, of bacteria or their products; lesions permitting their entrance and the depression of vital energy allowing them to multiply afterward. The lesions are

unavoidable, and the simple exhaustion following the muscular exertion of the expulsive acts equally so. Therefore it is that a parturient woman is in the same condition as a patient after a surgical operation. And the genital canal offers a more or less easy method of entrance to any poison, in any form, that will originate either a local or a general disturbance of the system; and therefore puerperal fever may be distinct, clinically speaking, but may, with equal certainty, be any form of septicæmia, pyæmia, or sapræmia (a name applied to those forms of infectious wound-disease produced by bacteria and with foul-smelling, putrefactive products), and may be due to any of the living ferments that are known to set up these processes. That it is not, in the vast majority of cases, due to an unorganized ferment, a chemical poison, is shown by the fact that, as a rule, the symptoms are general rather than local, and these symptoms can only be produced by something that is capable of reproducing itself.

In illustrating pyæmia or septicæmia from this point of view—that either of them is produced by the entrance of bacteria through the vagina or uterus—another description, amounting, perhaps, to about the same as that already given, would run as follows:

LESIONS OF PYÆMIA.—At the autopsy of individuals dead of pyæmia is found an œdematous putrefactive condition of the surface of wounds, with a gangrenous diphtheritic condition of the internal surfaces of the uterus and a phlebitis or a thrombosis of the regions originally affected. Bloody coagulations are found in the principal veins of the regions affected, which are often limited on the cardiac side by a branched and canulated anfractuous thrombus. Emboli are often found in the heart or pulmonary veins which are evidently detached from a venous clot: they are not infrequently seen in the pulmonary arteries, and sometimes there is also an endocarditis of the auriculo-ventricular valves and cardiac arterioles. There may be a nephritis, and finally multiple abscesses in various organs. These abscesses, which contain many masses of bacteria, are commonly found in the lungs, but are also exceedingly frequent in the liver, kidney, spleen, and muscles.

LESIONS OF SEPTICÆMIA.—Although there are degrees and variable gravities of pyæmia, they form a class of diseases more or less comparable to each other, and may be considered, clinically, to belong to one and the same group, because of the pretty constant presence of foci of suppuration. It must be remembered, however, that this distinction is merely one of clinical convenience, and has no bearing whatever upon the specific cause of the individual case or group of cases under consideration at the time. The real causes and the scientific determination of them can only be reached by bacteriological investigation. Setting aside, however, such cases as have just been described,

there remain a larger number that are classed as "septicæmias," and which are variable not only according to the degrees of intoxication, but also seem to vary, from a clinical point of view, more distinctly in their causes and their progress, and are therefore considered under many differing categories. For example, Jeannel¹ describes in surgical septicæmia—1, simple traumatic or primitive fever of the wounded, which may be considered as the result of absorption of the blood or contused and mortified tissue; 2, subacute or *foudroyant* septicæmia, which is the result of the invasion of wounds by the large bacilli of gaseous gangrene—erysipèle bronze, progressive gangrene, gangrenous emphysema; 3, simple acute septicæmia or putrid infection; 4, chronic septicæmia.

In simple acute septicæmia the wound is gray or purple, and shows no tendency to healing, but gives out a sanious and often offensive discharge. Fever usually follows the traumatic fever, and it appears as if the patient were affected with a type of continued or typhoidal fever, which sometimes marks its onset with a chill. Upon autopsy there is noticed a rapid putrefaction, which seems to have begun with or even before death. There are no characteristic visceral lesions, the changes apparent consisting of a softening, together with a granular or fatty condition of the hepatic cells; an acute parenchymatous nephritis in which the kidney is soft and anæmic; a tumefaction of the spleen with softening; a congestion of the intestines; and sometimes an inflammation of the pleura or pericardium. Such a surgical septicæmia differs, then, in general from a pyæmia by its symptoms as well as by the absence of metastatic suppuration. But many varieties occur, and a class has been separated of pyo-septicæmias, where there appears suppuration with the general symptoms of septicæmia. All of which goes to show the facts that have been so many times repeated, that there is no definite dividing-line between these two classes of affections, that their symptoms are so variable that the names must be used as mere clinical conveniences, and that no single cause can be considered to produce either the one or the other. These causes are so manifestly varied in number and activity that no rational consideration of pyæmias or septicæmias in general can be made, or of puerperal fever in particular, without a knowledge of the different organisms which have been found to produce changes of this sort, and of the clinical products of their activity.

Before entering upon our review of the work done in this direction, the third proposition, necessary to a belief in the assertion that bacteria are concerned in the production of puerperal fever by their entrance from without, must be given some attention. This was—that micro-organisms must be proved not to be capable of self-repro-

¹ *Encycl. Internat.*

duction anywhere—inside of the body more particularly, but outside as well. In other words, the old doctrine of *omnis orum ab ovo* must be reaffirmed and made to apply to these single-celled plants as well as to the cells collected together and making up the tissue of the living animal organism. Such an assertion is hardly difficult to support to-day, and it seems unimportant to pay any attention to it by those best skilled in modern research. The older experiments, to prove the truth of spontaneous generation by showing that a tightly-corked flask of fermentable material would ferment and show active forms of life in certain cases, even after prolonged boiling, have been entirely discredited since the discovery of the existence and resisting powers of spores; and the experiments tending to show a variation of form and pathogenic powers in an organism have been equally shown to rest upon faulty methods. Of this latter class the most prominent were the results obtained by Naegele, who claimed to have seen the harmless “hay bacillus” (*B. subtilis*), change into and take on the properties of that most virulent of organisms, the *Bacillus anthracis*. In this case there was evidently a substitution of the one organism for the other during the progress of the cultivation experiments—a result easily obtainable by reason of the greater activity of the one over the other—and the mistake might readily be made of supposing the original organism to be still present after the substitution had occurred, because of the very great similarity of the microscopie appearances of the two. A repetition of this apparent change in pathogenic properties has never been reobtained, even in the case of these two organisms, and most certainly never in any other case. Assertions to the contrary, derived from supposed clinical facts, are numerous without doubt, but no such assertions can be accepted to-day in the face of the enormous numbers of crucial experiments showing the contrary. It must be accepted, therefore, that, so far as proof goes, no micro-organism that has been isolated and cultivated under artificial conditions ever undergoes such a complete change of power as this. Variations in power are shown, and can be produced at will by variations in temperature, moisture, air-supply, etc., but even these are but poorly understood, and almost always such results are obtained only under forced conditions that are not likely of occurrence outside of the laboratory.

The facts as shown, then, prove that bacteria do not arise by spontaneous generation anywhere; and this being true, as well as the fact that they have never been found in the body in health, their presence there in disease must be ascribed to an entrance from without, and the finding of suitable conditions for their development after this entrance has been effected.

We have now, therefore, reached the point at which we can confidently affirm that bacteria or their products are the exciting causes of

such affections as the pyæmias and septicæmias, because we have shown that the line of experimentation suggested as a necessary preliminary to such an assertion has been carried out. That is, bacteria have never been found in healthy human tissues; they have been shown to be incapable of self-production; and the methods of their entrance into the body have been indicated.

In addition to this, the etiological importance of many of them has been most carefully studied and made out by the employment of the only means to that end—isolation, pure-cultivation, and successful inoculation-experiments. And here comes in a difficulty that has been encountered by all experimenters in the investigation of the special class of clinical disturbances grouped as puerperal fever. Many organisms have been found in cases of these disturbances and pure-cultivations of them have been made, but the result of inoculations of these pure cultures in the vaginae and uteri of parturient animals has been purely and uniformly negative. These same organisms introduced into the same animals by other methods, entaneons, subcutaneons, or circulatory, have invariably given characteristic disturbances, but not when introduced in the uterus or vagina, unless a special wound was made for their introduction. At first sight it would appear that if no results can be obtained in animals with organisms obtained from puerperal women by the same methods of introduction in animals as are claimed to occur in women, the assertion that the vagina and uterus are ordinarily the channel of entrance in women would receive a serious if not fatal blow. And such would certainly be the case if it were not for the marked difference in the condition of things after parturition in the females of man and the lower animals usually used for experiment. In the first place, the conditions of the females of the latter are in every way better for undergoing the processes of parturition. Living as they do under the laws made for them by nature, and being selected cases always by the free operation of the law of the survival of the fittest, parturition is, with them, as natural and almost as easy an act as defecation; and there is none of that tremendous physical and mental disturbance occurring in the women of civilized races and furnishing one of the favorable conditions for the entrance and activity of poisonous agents. So also there occurs none of the stretching and tearing of the tissues seen in civilized women, undoubtedly the results of faulty physical and moral laws. That these things are the result of such effects may be seen by glancing at the stories of parturition told in Englemann's *Labor Among Primitive People*, 3d ed., St. Louis, 1884. But the negative results obtained in experiments of this nature upon animals are further explained by the fact mentioned above—the differences in the anatomical conditions between the two. In the woman histological researches show that, at any rate, at the placen-

tal site there is a loss of the epithelium of the mucous membrane, and that this loss persists after the coming away of the placenta for a greater or less length of time which may be counted by days.

There is here, therefore, even in the most normal case of delivery, a place of entrance for bacteria and for the creation of local or systemic disturbances if any of pathogenic powers be present. On the other hand, whilst this loss of epithelium occurs in animals during parturition, it is almost, and in some cases completely, repaired before the coming away of the placenta, and at the most the repair is complete in a very short time after delivery, counting almost in minutes. Therefore there is not in such cases as there is in women any channel left open by nature for the entrance of bacteria, pathogenic or not; and the contrast between the two conditions is complete, civilized woman being after parturition in the condition most receptive for the entrance and development of bacteria; animals, on the contrary, being prepared by nature in the condition most effective under the circumstances for resisting the entrance of septic poisons by such channels as the genital tract. So that it is not surprising that inoculations in animals by simple uterine injections should be negative in their results, and the non-success of such experiments, explained in this way, cannot be taken even as negative evidence, the more especially as successful results are obtained if the point of the inoculating needle be introduced under the mucous membrane of the uterus or vagina.

Having reached this point in the discussion, it is extremely interesting to mention some of the organisms that have been found in patients affected with puerperal fevers, before entering upon the more systematic classification according to bacteriological methods that must be made before a true idea can be formed of what these processes mean. For, although it is true that a number of organisms have been found in the lesions of puerperal fever, nevertheless, considering the name as applied merely for convenience and not as denoting a specific disease, no complete view of the case can be had unless all the micro-organisms are considered that are known to produce septicæmic, pyæmic, or suppurative processes. Of the work done specifically upon puerperal fever only a brief view is necessary, and that only to show the truth of the assertion that more than one form of micro-organism is found in the processes included under this head, each of these organisms being known to possess the power of producing pathological changes when introduced into the animal body. The review of these observations will be brief also, because, from the point of view from which this paper is written, attention should be devoted to the whole subject of the causes of septicæmias and pyæmias, rather than to what has been done in one direction only, and that direction forming but a

small part of the entire subject. Pasteur and Doléris¹ give four varieties of bacteria occurring in cases of puerperal fever observed by them after the older methods of bacteriological research. These they classify as follows, according to their morphological arrangements: 1. Cylindrical bacteria (rods), appearing as large filaments just before or ordinarily after death,—“*bactéries séptiques de Pasteur*”—most commonly found in rapid septicæmias. 2. Micrococci in chaplets (chains, Streptococci), occurring in mild, attenuated septicæmias. 3. Micrococci in pairs, especially found in cases accompanied by suppurations. 4. Micrococci occurring singly or in irregular masses. Chauveau, cited by Arloing,² considers that all varieties of puerperal septicæmia can be produced by an organism which is arranged singly, in pairs or in chains, but that the activity of this organism is not proven to be confined to puerperal fever alone—an illustration of the point that it is being attempted to show in this paper. E. Fraenkel found in two cases dead of puerperal fever small rod-shaped organisms in the spleen which corresponded very closely with Rosenbach's “*Bacillus saprogenes* III.” and Passet's “*Bacillus pyogenes fetidus*” (*vide infra*). These organisms upon isolation and cultivation were found to be harmless upon subcutaneous inoculation in mice, guinea-pigs, and rabbits, and to the two latter upon intraperitoneal injection; but they produced death in rabbits in twenty-four hours after intravenous injection, and an abdominal effusion in mice after from three to six hours—seldom later—followed by death and the discovery of the same bacilli in the blood, lungs, heart, and pleura. Of the later investigations these are the most interesting. Brieger³ investigated seven cases, and found in all the *Staphylococcus pyogenes aureus* and the *Streptococcus pyogenes*. In only one case did he find any form of bacillus. Subcutaneous inoculations in animals of the blood from these cases gave no results, and from this fact Brieger concludes that it is the *toxine*—a ptomaine formed by these organisms—that causes the fatal result in puerperal fever; in other words, that it is the product of bacterial activity, and not the bacteria themselves, that produces the effects. Karlinski⁴ experimented upon the milk of a lying-in woman who was affected with erysipelas. Using the method of plate cultures for isolation, he found the *Staphylococcus pyogenes aureus*, the *Staphylococcus pyogenes albus*, the *Staphylococcus cerens albus*, and the *Staphylococcus cerens flavus*. The child of this mother was attacked by a septicæmic process, consisting of catarrhal gastritis and enteritis, peritonitis and pleuritis, double parotitis, and lobular pneumonia, and the same bacteria were found in the blood and intestinal contents of the child as

¹ *La Fièvre puerpérale et les Organismes inférieurs*, Paris, 1880.

² *Recherches sur les Septicémies*, Lyon, 1884.

³ *Charité Annalen*, Jahr. 1888, S. 198.

⁴ *Wiener med. Woch.*, 1888, No. 28.

were present in the milk of the mother—a striking coincidence, surely, but, as the author says, not enough, being but one case, to actually determine the etiology of the disease in the child.

Netter, by Pasteur's method of inoculating the saliva under the skin and observing the resulting lesions, found in healthy persons the *Streptococcus pyogenes* in 5.50 per cent. (7 out of 127 cases), Friedländer's pneumonia bacillus in 3.93 per cent., and Fraenkel's pneumo-bacillus in 20 per cent. In two cases both these latter were seen.

These instances furnish evidence enough of the variety of organisms that may be found in the processes included under the head of puerperal fever. Many other observations have been made of a similar character and with a similar result—*i. e.* the demonstration of the fact that more than one variety of pathogenic organism may, and generally does, occur in situations like those under consideration. And other experiments have been made to show how they get into the body. The means of conveyance are unquestionably, in most cases, the hands and instruments of the attendants; and how this may occur in the case of the hands is well shown by the difficulty experienced in cleansing them. Furbringer¹ and others have studied this point very carefully from a bacteriological point of view, and when the difficulty of rendering the hands aseptic which they found in the way is considered, it is easy to see how little effect the ordinary washing would have upon any septic material upon them, and how unconsciously this might be carried about upon the fingers.

But more recent investigations seem to show the possibility of puerperal infection although there may be no pathogenic bacteria about the attendants, instruments, or atmosphere in contact with the woman during or after labor. This, of course, could not happen unless pathogenic bacteria had their habitat in the genital tract of healthy women; and this has usually been supposed not to be the case, the bacteria found there in health (in the vagina) having been thought to be innocuous. Winter² found that neither the Fallopian tubes nor the uterine cavity contains bacteria in health; that, on the other hand, the secretions from the cervix and vagina of healthy women contained many bacteria; and that in one-half the cases some pathogenic varieties were found. But he goes on to say that the virulence of these organisms was attenuated, because inoculation-experiments made with them were unsuccessful.

It does not seem to have occurred to this author nor to the commentators upon his work that this failure of his inoculation-experiments was to be ascribed to another cause, and that is the fact that the organisms he found were not pathogenic in the first place. For his mere

¹ *Untersuch. und Vorschriften und die Desinfektion der Hände des Arztes*, Wiesbaden, 1888.

² *Zeit. f. Geburtshilfe*, Band xiv. S. 443.

observation of similarity cannot be allowed to prove identity, and the failure of the crucial test, the inoculation-experiments, must be ascribed to faulty diagnosis, and not allowed to upset one of the strongest points in bacteriology, that bacteria do not change their nature except under most unusual conditions, and that rarely. Therefore when similarities of growth to a known pathogenic organism are seen, and inoculation-experiments fail to produce the results usual when the true organism is used, the failure must be set down to mistaken identity or faulty *technique*, and not to a supposed "attenuation" of virulence. Winter's work, about which much has been said, is therefore unreliable to a degree, so far as furnishing any freedom from personal responsibility for the occurrence of puerperal fever is concerned.

Orth¹ reaches a different result from Winter upon the first point, for he examined a number of women during the puerperium, and, contrary to Winter's results, not only found no pathogenic organisms, but he found no bacteria at all in the uterus or upper portion of the vagina. He reaches the conclusion as the result of his experiments that the lochia of healthy women are entirely innocuous, and do not become otherwise except under the influence of introduced organisms. Fehling² also reaches conclusions in accordance with these facts. He considers that direct infection, since the introduction of careful methods of disinfection of the hands and instruments, is rare. He believes that pathogenic organisms come, not infrequently, from infected linen, furniture, and air, and he divides infection into two classes, primary and secondary. He thinks that primary infection is that resulting from the direct introduction and contact of pathogenic germs from without, whilst secondary infection is due to the absorption of ptomaines produced by the activity of bacteria which have entered the genital canal during, before, or after labor. Strauss and Sanchez-Toledo³ investigated the subject of the occurrence of bacteria in the uterus or vagina after normal parturition. They claim that Doléris⁴ considered it from the pathological, and not from the physiological, point of view; and they also mention Döderlein's results, finding that the lochia of healthy persons were harmless, but that the lochia of the sick were pathogenic and usually contained the *Streptococcus pyogenes*. These authors failed to find any bacteria in the uteri of the animals examined, and Goenner was equally unsuccessful in the case of women.

Strauss and Sanchez-Toledo found, further, that it was possible to introduce large numbers of anthrax bacilli, vibrions septiques, bacillus of charbon symptomatique, and *Staphylococcus pyogenes aureus* into

¹ *Arch. f. Gynäkol.*, Bd. xxxii. Hft. 3, 1888.

² *Ibid.*

³ "Recherches microbiologiques, etc.," *Annales de l'Institut Pasteur*, August, 1888.

⁴ "Essai sur la Path. et la Therapeut. des Accidents infectieux des Suites des Couches," *Thèse de Paris*, 1880.

the uteri of animals just after parturition without result, and explain the fact by the differences in anatomy between the case in animals and in women that have been already spoken of. Döderlein, in further illustration of what may occur, describes a case of instrumental abortion after hemorrhage which was followed by fever and death. Streptococci were found in the uterus, knee, middle finger, and in the pus at the base of the ankle. Death occurred from purulent meningitis, with no peritonitis. The patient had had erysipelas a year previously, and the cervical lymphatics were softened and the probable source of infection. In connection with this case Döderlein stated his belief that puerperal septicæmia arises from the infection of the uterine cavity or by specific infection of the lesions occurring during labor—that the organisms producing the symptoms can be introduced from the abdominal cavities, intestinal disease, or by masturbation, so as to infect the cavity of the uterus; and he remarks that it is evident that we cannot discuss auto-infection clearly until we are certain of the thorough disinfection of the uterus and vagina of the cases under consideration.

The influence of an agent not often thought of in connection with septic absorption in puerperal fever has been discussed by Hicks,¹ who suggests that the manipulations of the uterus, and the motions consequent upon these manipulations, may sometimes induce absorption that would not otherwise occur; which is very probably the case. Thus, the sudden withdrawal of the hand after firm compression of the abdominal walls might favor an indrawing of material from the vaginal to the uterine cavity; and another favoring element may be found in the sudden turning on the side from the back. In such a case the absorption would be favored from the inner surface of the uterus, because its walls are often flabby, and upon turning over the abdomen and uterus fall decidedly if unsupported, and there is at once a tendency to a vacuum which determines a flow toward the abdominal cavity. Such influences as these are undoubtedly aiding factors in the accomplishment of the absorption of septic poisons in all cases, and are of unquestionable importance in studying the means of the production of the results seen from such absorption; and they should be guarded against, perhaps not as carefully as the presence of the poison itself, but nevertheless as being elements in the important system of prophylaxis that we are endeavoring to perfect.

We have given illustrations of what has been done in the investigation of the bacteria occurring in puerperal fever, and we have seen that they are of many differing kinds, even under the microscope, and that these differences are shown to be even more frequent when the organisms found are subjected to cultivation and isolation. There is not, therefore, any simple organism, any specific living ferment, which

¹ *Am. Journ. Med. Sciences*, July, 1888.

is the cause of puerperal fever. We have shown, too, how many sources of entrance to the body there may be for the organisms that will produce pyæmic or septicæmic processes; that this channel of entrance usually occurs, and may always occur, in the vaginal canal or uterine cavity, but that it may also be in other parts of the body,¹ where the micro-organisms, entering the body at one place, are transferred to the place of least resistance by the blood current, lymph-channels, or leucocytes, and manifest their presence there by the pathological processes that follow their activity. It will be seen, therefore, that for a proper consideration of puerperal septicæmia alone a consideration must be made of septicæmias and pyæmias in general, and that anything that may produce any of these processes may equally be concerned in the production of that especial form of these processes called puerperal fever. It is necessary, therefore, to speak of each organism that has been isolated from a septicæmic, pyæmic, or sapræmic process, or, in fact, from any other source, and which has been cultivated and found upon inoculation to produce suppuration or septicæmic changes in inoculation-experiments upon the lower animals. This will include, of course, a description of organisms that have never been found in the course of puerperal fever, but such an inclusion is justifiable and necessary because of what has already been said. Because any micro-organism that is known to possess the power of producing such pathological changes as are under consideration may at any time be the cause of a special case of puerperal fever, and because it has not been observed to be so, it is unwarrantable to assume that it cannot.

The micro-organisms connected with suppurative, pyæmic, septicæmic processes having been considered, the view of the whole will not be complete without as perfect a reference as is to-day possible to the action of those products of theirs—the animal alkaloids—in the causation of the processes in which the bacteria occur, and of whose activity they are the result. In speaking of the various bacteria that will be mentioned, the order of frequency of their occurrence will be followed, and more especially of their occurrence in puerperal affections of the nature of those being studied. The description is based upon that required by the best modern scientists for the identification of a bacterium, and will include, so far as possible, a mention of the discoverer, its origin, shape and usual arrangement, motility, behavior under cultivation in various media, the best temperature for its development, rapidity of growth, spore-formation, gas-production, power or not of liquefying nutrient gelatin, behavior toward aniline dyes, and pathogenic properties. By such a course, then, the first organism to be spoken of would be the—

1. *Streptococcus pyogenes* of Rosenbach and Passet. Found in

¹ Vide Döderlein, *supra*, and Rosenbach, *Der Eit. Phleg. des Menschen*.

progressive erysipelas-like suppurations, and consisting of cocci arranged in chains of sometimes as many as thirty, but often of no more than two. Has no especially characteristic method of growth, except that it is sluggish in any culture-medium, develops best at the temperature of 35–37° C. (blood temp.), but fairly well at summer temperature. Its growth is slow, being only 2–3 mm. broad in needle-cultures after two or three weeks. After four months the culture is nearly if not quite dead. Not especially affected by the absence of oxygen, and changes albumen in a vacuum. Does not liquefy gelatin, and can be stained by Gram's method (*i. e.* decolorizing with iodine and iodide of potash sol.). Upon inoculation produces erysipelas-like suppuration.

2. *Streptococcus erysipelatis*. Fehleisen.¹ Found in the cutaneous lymph-channels in erysipelas. Very small cocci, occurring in pairs or long chains, more especially upon culture in bouillon. Grows only in the needle-track in gelatin, not on the surface; very little upon agar-agar, not at all upon potato, and very profusely in blood-serum at 37° C. Its best development is at 37° C., but slow at that. Does not liquefy gelatin, and is stained by Gram's method. Produces in rabbits a sharply-defined spreading redness without suppuration, and a characteristic erysipelatos process in man. Most probably identical with No. 1.

3. *Bacillus œdematis maligni*, "vibron septique." Hesse,² Gaffky,³ Koch,⁴ Pasteur,⁵ Liborins.⁶ Found in garden earth; consists of rods of from 3.0–3.5 micro-millimeters long, and $1-1\frac{1}{10}$ micro-millimeters broad, usually occurring two together, but sometimes consisting of chains from 14 to 40 micro-millimeters in length. It is smaller than the anthrax bacillus, with rounded ends. It is very motile, and has no special characteristics as colonies. It grows best at the temperature of the body, and very rapidly. Produces spores at its ends at the close of the first day, and most rapidly at 37° C., more slowly at summer temperature. Is entirely anærobic, growing only in the absence of oxygen. Produces no gas; liquefies gelatin; stains with all aniline colors, but not with "Gram." Kills guinea-pigs in from twelve to twenty-four hours with appearances of widespreading subcutaneous œdema and gas-production.

4. *Staphylococcus pyogenes aureus*. Rosenbach,⁷ Passet.⁸ Very frequently found in pus, consisting of cocci of varying size arranged in masses or pairs, and of a medium size of 0.87 micro-millimeters.

¹ *Die Aetiologie des erysipels*, Berlin, 1888.

² *Deut. med. Woch.*, 1885, No. 14.

³ *Mitt. a. d. Kais. Ges.-amt.*, Bd. i. S. 1.

⁴ *Ibid.*, S. 54.

⁵ *Bull. de l'Acad. de Méd.*, 1887, p. 793.

⁶ *Zeit. f. Hyg.*, Bd. i. S. 158.

⁷ *Mikro-organismen bei den Wundinfektionskrankheiten des Menschen*.

⁸ *Aetiologie der Eitrigen Phlegmonen des Menschen*.

Its specially characteristic appearance under cultivation is the orange-yellow color of its colonies, its liquefaction of nutrient gelatin, and the foul smell of the colony upon potato. It grows best at from 30° to 37° C., and somewhat more slowly at summer temperature. Its growth in general is rather rapid. Spores have never been found, but the organism shows a remarkable resistance to destructive agents. It lives a long time without oxygen, changes albumen, and liquefies gelatin. Stains well by Gram's method. Produces many varieties of suppuration by any of the methods of inoculation.

5. *Micrococcus of Osteomyelitis*. Becker.¹ Found in the osteomyelitis of sheep. Probably identical with the preceding, because answering in every way to the description of the former under the microscope, cultivation, and inoculation.

6. *Staphylococcus pyogenes albus*. In every way identical with No. 4, except that it produces no pigment, its colonies being white. A colony retained its vitality for three years and a half without oxygen.

7. *Micrococcus pyogenes tenuis*. Rosenbach. Rare, but when it is found it occurs in widespreading malignant phlegmons, and as cocci somewhat larger than the staphylococci, but without any regular arrangement. It grows in nutrient agar-agar very slowly as a thin almost transparent layer, and does not liquefy gelatin. Some of the large individuals have a deeper staining at their poles. Its pathogenesis has not been shown.

8. *Staphylococcus pyogenes citreus*. Passet. Found in pus, and morphologically, as well as physiologically, identical with No. 4, except that it produces a lemon-yellow color in its colonies.

9. *Staphylococcus cereus albus*. Passet. Found in pus, and consists of cocci of irregular size occurring in masses, and occasionally in chains, growing on gelatin as white or grayish-white layers with thickened, waxy-looking edges. Is non-liquefying, and has not had its pathogenesis investigated.

10. *Staphylococcus cereus flavus*. Is exactly like the preceding, except that it is found very infrequently, and produces a lemon-colored pigment in its colonies, which is darker than occurs in No. 8.

11. *Bacillus saprogenes I*. Rosenbach. Found in the white plugs of the follicles of the tonsils. Is a large bacillus, with large spores often to be seen. Produces yellowish-gray colonies on agar-agar, with a smell like burnt cooking and an extremely foul smell upon blood-serum. Grows slowly, produces very large endogenous spores, is aerobic. With oxygen produces an intensely foul odor; without it, a very gradual and slow putrefaction of albumen. No pathogenesis yet shown.

¹ *Deut. med. Woch.*, 1883, No. 46.

12. *Bacillus saprogenes* II. Rosenbach. Found in the secretions of foul feet. Is a bacillus somewhat smaller than the preceding, growing upon agar-agar as numerous fine drops, coalescing, and then forming a uniform translucent and then opaque layer with the odor of foul-smelling feet. Has a very rapid surface growth, is aërobie and facultatively anaërobie, with an unbearably foul smell when the access of oxygen is unrestricted; less so if the supply of oxygen be diminished. It has invasive and pyogenic properties.

13. *Bacillus saprogenes* III. Rosenbach. Found in septic gangrenous pus. Grows without special characteristics upon agar-agar, with medium rapidity. With oxygen produces rapid change in albumen, slower without, and a very foul odor when cultivated in milk. Upon injection, either subcutaneous or in the joints of rabbits, it produces a yellowish-green infiltration, with wide destruction of tissue and a foul smell.

14. *Bacillus pyogenes foetidus*. Passet.¹ Found in an abscess of the anus. Short staffs with rounded ends. $1\frac{4.5}{10.0}$ millimeters long by $\frac{4.5}{10.0}$ broad, often occurring in pairs or more together in chains. It possesses slight motion, and presents nothing characteristic upon culture, but a clear brown colony upon potato of extremely rapid growth, non-liquefying, and upon injection into mice and guinea-pigs produces death in twenty-four hours, with masses of bacilli in the blood, but none at the point of inoculation or in the organs.

15. *Staphylococcus salivarius pyogenes*. Biondi. Found in the abscess-contents of a rabbit inoculated subcutaneously with saliva from a case of scarlet fever. Cocci smaller than most known, 0.3μ to 0.4μ in diameter, occurring in irregular masses. Has no especial characteristics under cultivation except the golden-yellow color of the colonies in agar-agar at blood-temperature. Shows great resistance to low temperatures, cold, and drying. Grows very slowly in gelatin, rapidly upon agar-agar. Liquefies gelatin slowly. Stains best by Gram's method, and produces localized suppuration upon inoculation into mice, guinea-pigs, dogs, and rabbits.

16. *Coccus salivarius septicus*. Biondi.² Found in the saliva of a person very ill with puerperal septicæmia. Round cocci, sometimes almost oval in form, with a depression in the centre visible upon very careful focussing. Shows no especial characteristics on cultivation, except occasionally an almost black color in colonies upon gelatin plates. Grows best at blood-temperature, but also at 18° to 20° C., and with medium rapidity, and does not liquefy gelatin. It stains easily with all aniline colors, and also by Gram's method. It is pathogenic for mice, guinea-pigs, and rabbits, killing them in from four to

¹ *Loc. cit.*

² *Zeit. für Hyg.*, Bd. ii. S. 217.

six days. The bacilli are found in the blood and in the organs, but there is absolutely no sign of any suppurative process.

17. *Bacillus salivarius septicus*. Biondi.¹ Found in the sputum of healthy and unhealthy persons. Short elliptical rods, with slightly pointed ends and relatively thicker bodies, occurring as pairs in the blood and in fluids, but in the tissues as pairs with a capsule sometimes, and sometimes in chains and masses. Grows best in plates with the addition of a small amount of phosphoric, hydrochloric, or nitric acid, but without any other special characteristics, except that it does not cloud beef-bouillon. Best development at 35°–37° C., and its greatest virulence is shown when grown at 20°–22° C. There is no development at 10° C., and at 8°–9° C. it loses its virulence and transmissibility to other nutrient media as well. It grows extremely slowly, and produces no spores, being very susceptible to drying. It grows under mica, and in an atmosphere of hydrogen also. It does not liquefy gelatin. Stains with all aniline colors and with Gram, and is pathogenic for mice and rabbits, which it kills in from twenty-four to forty-two hours to fifteen to thirty days with all the clinical symptoms and anatomical changes of an acute or subacute form of septicæmia. It shows the most intense changes at the seat of inoculation, and is non-pathogenic for guinea-pigs, differing in this respect from No. 22.

18. *Bacillus of Chicken Cholera*—"Choléra des poules" of Pasteur. Found in fowls diseased with chicken cholera. Short rounded ends, staffs, growing often in threads, and staining characteristically. It possesses no motion; shows no marked peculiarities under cultivation; grows at both ordinary and blood temperatures, but very slowly. Does not develop under mica, and is non-liquefying in nutrient gelatin. The poles of the organism stain more deeply than the centre, so that it often looks like a diplococcus. It takes the usual nuclei-staining colors in sections, but cannot be demonstrated by Gram's method. The smallest portion of a culture produces characteristic symptoms in birds, followed by death. Pigeons, sparrows, pheasants, mice, and rabbits are susceptible, whilst in guinea-pigs, sheep, and horses it produces abscesses localized at the point of inoculation.

19. *Bacillus of Rabbit Septicæmia*. Koch.² Found in putrid infusion of meat, and resembling the preceding in every respect; probably identical with it.

20. *Bacillus of Pseudo-œdema*. Liborius.³ Found in the œdematous fluid and tissues of a mouse inoculated with garden earth. A thicker bacillus than No. 3, with a thin capsule. Grows at ordinary temperatures, without special characteristics except the formation of a gas-bubble on the top of the colonies in gelatin, and slowly. It forms

¹ Zeit. für Hyg., Bd. ii. S. 196.

² Wundinfektionskrankheiten.

³ Zeit. f. Hyg., Bd. i. S. 163.

two spores in each rod, is anaërobic, produces an odor resembling old cheese or rancid butter, and does not liquefy gelatin. It kills rabbits and mice very rapidly, but very few bacilli are found in the dead animals, so that the result is probably due to the formation of a ptomaine.

21. *Bacillus of Mouse-septicæmia.* Koch,¹ Gaffky and Loeffler.² Found in putrid-meat infusions and foul fluids. Is a very small rod, —0.8 to 1.0 μ long and 0.1 to 0.2 μ broad, usually occurring in pairs, and presenting at first sight an exceedingly close resemblance to fine needle-shaped crystals. Has no motion. Presents a characteristic appearance in gelatin needle-cultures, branching out from the needle-track in very fine white sprays looking like lines of vapor. Shows a very slight liquefying power in strongly alkaline nutrient-gelatin, and does not grow at all on blood-serum. It develops very slowly, produces spores, grows under mica, and is non-liquefying. Takes the usual nuclei-staining aniline colors, and may be differentiated by Gram's method. It kills house-mice in forty to sixty hours after cutaneous inoculation, but has no effect upon field-mice.

22. *Mouse-septicæmia-like Bacillus.* Bicustock.³ Found in feces. An unusually small bacillus, somewhat larger than Loeffler's bacillus of "schweine-rothlauf." Length to breadth as 0.8 μ is to 0.4 μ , and easily confounded with micrococci. Possesses no motion. Grows very slowly without special characteristics upon agar-agar. Produces oedematous and erysipelatous disturbances in mice and rabbits.

23. *Diplococcus pneumoniae.* A. Fraenkel, Weichselbaum,⁴ Fraenkel.⁵ Found in the sputum of lung diseases, especially in the rusty-brown sputum of pneumonia, in bad cases of empyæma, and in the exudation of a case of cerebro-spinal meningitis. Oval diplococci, whose members are lancet-shaped; under a high power they appear as rods whose ends are joined together by a fine filament, and often occur in chains of five or six elements. A capsule is often seen surrounding them in preparations from the body, but never in cultures. Possesses no motion, and is distinguished from all other cultures by the extreme delicacy of its growth. Does not develop below 24° C., best at 35°, and loses its virulence by variations in temperature. Grows very slowly at the best, is non-liquefying in gelatin, takes all aniline colors, and may be stained after Gram's method. Is pathogenic for mice, guinea-pigs, and rabbits, killing them all in twenty-four to forty-eight hours; and there are masses of the organism with capsules to be found in the blood and all the organs.

¹ *Zeit. f. Hyg.*, Bd. i. S. 163.

² *Mitt. a. d. Kais. Gesund. amt.*, Bd. v. S. 80 und 135.

³ *Zeit. f. klin. Med.*, Bd. viii. Heft 1.

⁴ *Mikrobe der Sputumsepticaemie.*

⁵ *Zeit. f. klin. Med.*, Bd. x. S. 401; *ibid.*, Bd. xi. Heft 5 und 6; and *Deut. med. Woch.*, 1884, No. 25.

24. *Bacillus resembling the Pneumonia bacillus*.—Passet.¹ Found in pus, and consisting of cocci, occasionally short rods. Grows on the top of gelatin in needle-cultures, rarely in the needle-track, and after three or four weeks produces a brown staining of the gelatin and foul odor. Grows very rapidly. Is ærobic, produces no gas, and is non-liquefying. Injected into serous cavities, it produces a suppurative disturbance, but with slight changes after subcutaneous inoculation, and none at all after inhalation.

25. *Diplococcus intracellularis meningitidis*. Weichselbaum.² Found in the fresh exudation of cerebro-spinal meningitis in six cases. Cocci sometimes single, usually in pairs or fours, or forming small masses. Their situation in the cells is characteristic. Grow without especially marked characteristics, only at blood-temperature, and with medium rapidity. Stains best in sections with Loeffler's alkaline methylene-blue and by Gram's method. Is pathogenic for mice, guinea-pigs, rabbits, and dogs, especially for the first.

26. *Bacillus septicus agrigenus*. Nicolaier, Flügge.³ Found in the earth of manured fields. Bacilli like Nos. 18 and 19, but somewhat larger. Grows without special characteristics, and is non-liquefying. Behaves toward aniline colors like No. 19, but does not stain so sharply. It is pathogenic to mice, field-mice, and rabbits, but a relatively small number of the organisms are found in the blood or organs.

27. *The Streptococcus pyogenis malignus*. Flügge.⁴ Found in the necrotic tissue of a leukæmic spleen, and cannot be distinguished under the microscope from Nos. 1 and 3. It produces the same sort of colonies upon cultivation as Nos. 1 and 3; grows more slowly than they do, and is non-liquefying in gelatin. Is pathogenic to mice and rabbits, with post-mortem appearances similar to those produced by Nos. 1 and 3.

28. *Streptococcus septicus*. Nicolaier and Guarneri.⁵ Found in foul earth and similar to other streptococci, except that it has not such a tendency to form chains under all circumstances, and occurs in tissues mostly as pairs. Grows on gelatin as small fine colonies, similar to other streptococci. Grows still more slowly than the preceding, and is non-liquefying. Is pathogenic to mice and rabbits.

29. *Streptococcus septo-pyæmicus*. Biondi.⁶ Found in the saliva of one individual with a phlegmonous angina, and of two others with primary erysipelas of the larynx. Round cocci 0.7 to 0.8 μ in diameter, occurring in chains, of which the pairs are often made up of two of irregular size. Grows without special characteristics, except a yellowish-gray color, in colonies on agar-agar, at blood temperature after forty-eight hours. Is non-liquefying, and does not possess pathogenic

¹ *Loc. cit.*

³ *Mikroorganismen*, Leipzig, 1886, S. 257.

⁵ Flügge's *Mikroorganismen*.

² *Fort. der Med.*, 1887, No. 18.

⁴ *Ibid.*, 1886, S. 153.

⁶ *Zeit. f. Hyg.*, Bd. ii. S. 225.

properties for mice, guinea-pigs, and rabbits, although it produces a typical erysipelas in the latter when injected into the ear. Very likely identical with No. 3.

30. *Streptococcus articulorum*. Loeffler¹ and Flügge.² Found in various forms of diphtheria in and out of the affected mucous membranes. Occurs in chains of sometimes more than a hundred, among which some are much larger than others; and in these large ones a transverse division may almost always be seen to be going on. Grows without any special characteristics, very slowly, and is non-liquefying in gelatin. Is pathogenic for mice; guinea-pigs are not susceptible. Intravenous injection in rabbits produces a typical joint affection, with death usually following.

31. *Bacillus necrophorus*. Loeffler.³ Obtained in the processes resulting from inoculation of particles of condylomata in the anterior chamber of the eye of a rabbit. Bacilli of varying lengths, but of equal thickness, often joined in long undulating threads. Does not grow upon gelatin or agar-agar, and very slightly on horse blood-serum, and best in neutralized rabbit-broth. It is pathogenic to rabbits, producing a necrotic, cheesy sort of process.

32. *Briege's Bacillus*.⁴ Found in feces and artificially prepared putrefactive mixtures. Small rods, a little longer than broad. Very characteristic growth on gelatin-plates, like the markings on tortoise-shell, and on potato as a dirty-yellow layer. Pathogenic to guinea-pigs by subcutaneous injection, but produces no result if introduced by the mouth or anus.

33. *Emmerich's Bacillus*.⁵ Weisser.⁶ Found by Emmerich in needle-cultures from blood, tissue-serapings, and discharges from cholera patients at Naples; by Weisser in normal as well as abnormal human feces, in the air, and in foul fluids. Short rods, singly or in twos, rarely more. One and one-half times as long as broad—about the size of the typhoid bacillus. Has no motion, and presents no diagnostic characteristics upon cultivation. Resisted twelve days' freezing at 24° C., and four weeks' drying at summer temperature. Spores not observed, but their presence very probable, because of this resistance. Is non-liquefying in gelatin, and does not stain by Gram's method. Its pathogenic powers especially investigated in regard to the production of choleraic symptoms.

34. *Bacterium coli commune*. Escherich.⁷ Present constantly in the intestinal canal of men and animals examined and in the stools of

¹ *Mitt. a. d. Kais. Ges. amt.*, Bd. ii. S. 451.

² *Mikroorganismen*, S. 153.

³ *Loc. cit.*, S. 493.

⁴ *Berl. klin. Woch.* 1884, No. 14.

⁵ *Deut. med. Woch.*, 1884, No. 50; *Berlin. klin. Woch.*, 1885, No. 15.

⁶ *Zeit. f. Hyg.*, Bd. i. S. 315.

⁷ "Die Darmbaet. des Sauglings und ihre Beziehungen z. Physiol. der Verd., 1886," *Fort. d. Med.*, 1885, No. 17.

infants. Its typical shape is a long rod, eight to twelve times as long as broad, with irregular sides, so that it may look like a chain of oval or round organisms; two rods usually occur together. It is possessed of sluggish motion; produces a pea-yellow color upon potato, but without other especially characteristic appearances on other nutrient media, and grows best at body-temperature. Grows with medium rapidity, and spores have never been observed, although clear, unstained spaces are often seen in the rods themselves. Is aërobic, produces a gas under anaërobic conditions, and does not liquefy gelatin. Produces diarrhœa and collapse after subcutaneous or intravenous inoculation in rabbits and guinea-pigs; is not pathogenic in mice.

35. *Bacillus of Intestinal Diphtheria in Rabbits.* Ribbert.¹ Found in the organs of rabbits which have died of a spontaneous diphtheritic process of the intestines. Rods of 3–4 micro-millimeters in length, and $1-1\frac{4}{10}$ micro-millimeters in thickness, with rounded ends and often occurring in chains of two and more. No marked characteristics under cultivation; grows best at the temperature of the body, and with fair rapidity. Its growth is least when no oxygen from the air comes in contact with the culture. It is non-liquefying, and stains well with aniline-water fuchsin, and not at all by Gram's method. Produces death in rabbits in three days after injection into the ear vein, with masses of bacilli in the liver and spleen, and after subcutaneous inoculation a swelling of the neighboring lymph-glands. Injection into the abdominal cavity shows suppuration and inflammation of the entire intestinal tract inside and out, with a necrotic change very like the diphtheritic processes in man.

36. *Micrococcus botryogenus.* Jolme; Rabe.² Found in tumefied swellings in horses. Micrococci of $1-1\frac{5}{10}$ millimeters in diameter, occurring in pairs or chains. With not very characteristic growth upon culture-media, but a characteristic odor. Slightly liquefies gelatin. Kills guinea-pigs with symptoms of septicæmia, and produces a widespread œdema in sheep and goats.

37. *Micrococcus of Progressive Lymphomata in Animals.* Found in the expectoration of pneumonia following measles. Oblong cocci, with rounded, stumpy ends, usually occurring singly or in pairs, and from 0.4–0.6 millimeter in diameter. Produces a grayish-yellow pigment in gelatin and a yellow color on potato. The best temperature for its growth is from 18–37° C., it is much delayed at from 46–48° C., and it is destroyed at from 48–60° C. It grows rapidly on the surface of gelatin, and best with the free entrance of air, and is non-liquefying. Has no characteristic stain, and can be easily colored by Gram's method. The inoculated animals—dogs, rabbits, guinea-pigs, and

¹ *Deut. med. Woch.* 1887, S. 141.

² *Zeit. f. Thiermed. u. Path.*, Bd. xii. S. 137.

house-mice—die in from seven to fourteen days, with an enormous swelling of the internal organs, and a collection of gray or grayish-yellow nodules which assume the type of granulomata.

38. *Bacillus of Rhinoscleroma*. Von Frisch,¹ Paltanuf, and Von Eiselsberg.² Found in the scrapings of a tumor in rhinoscleroma. Short, rounded-ends bacilli, two or three times as long as broad, or oval cocci which may grow into longer bacilli or threads. Has no motion, and grows like Friedländer's pneumonia-bacillus. Best development at 36–38° C., and with medium rapidity. Often produces gas on potato, and does not liquefy gelatin. Stains well with Loeffler's methylene-blue solution. Stained with aniline-water gentian-violet, and then treated with dilute acetic acid or Ziehl's carbolic-acid fuchsin solution, the bacilli appear surrounded by a capsule. Upon inoculation into animals the bacilli produce suppuration of the pleura, abscesses in the subcutaneous and muscular tissue, with death of the inoculated animals.

39. *Tetanus Bacillus*. Nicolaier.³ Found in earth. Fine bacilli, somewhat longer than, and not so thick as, Koch's bacillus of mouse-septicæmia. Grows on blood-serum at blood-temperature. Presents a characteristic spore formation, and stains best with fuchsin. Produces tetanic symptoms in the animals inoculated, with suppuration at the point of inoculation, and bacilli in the channels of the ischiatic nerves and spinal cord.

40. *Bacillus of Aene Contagiosa in Horses*. Dieckerhoff and Grawitz.⁴ Found in the pus and dried scales of pustules obtained by inoculating a horse with "Englischen Pocken." Short straight or slightly curved bacilli, 0.2 millimeter in size. Grows without marked characteristics, but has a perceptible odor. Its best development is at 37° C., and it does not grow at all under 17° C. It grows rapidly on blood-serum, but very much more slowly on other nutrient media. Stains quickest and best in watery solutions of fuchsin, but a very beautiful color may be obtained by using Gram's method. Produces a typical aene upon rubbing into the skin of horses, calves, sheep, and dogs, and suppuration in rabbits. Upon subcutaneous injection there occurs an erysipelatous swelling, with a general intoxication of the animal, with mortification and suppuration.

This completes the list of organisms that have been found in the suppurative or pyæmic or allied processes in man or the lower animals, and that have been isolated, cultivated, and described, so that there may be comparisons made by new workers in the same field.

But the enumeration includes others than these. There have been put down, as necessary to a complete review of our present knowledge,

¹ *Wien. med. Woch.*, 1882, No. 32.

³ *Dent. med. Woch.*, 1884, No. 52.

² *Fort. d. Med.*, 1886, No. 32.

⁴ *Virch. Arch.*, Bd. cii. S. 148.

not only those organisms that have been found in processes actually going on, but also those found in other situations, and shown to be capable of setting up local or general disturbances of the nature of those we are considering upon introduction in pure cultures into animals.

These, of course, have not the direct value of the organisms found in pathological processes in man and shown to be capable of setting up similar changes in animals. But they cannot possibly be neglected, even if this link in the chain of evidence be wanting, for if they can so easily set up extensive changes in the lower animals—changes precisely similar to others occurring in animals and man—and if their habitat may be so widespread as is indicated by their occurrence in the earth or air, it must be assumed that these organisms also may be among the causes of changes more or less extensive in man, although they have not yet been found in those changes.

They should be looked for, however; and that an organism known to be capable of producing septicæmic or suppurative changes in animals may not be capable of doing the same thing in man can never be positively asserted, and may be put forward with only comparative security, and then only after an enormous number of examinations have been made—including cultivations—of these processes as occurring in man.

It is for this reason that so many of the organisms already described have been spoken of here in a place that at first thought seems inappropriate for such mention. But it is well for obstetricians to know what has been done upon the general subject, and how this work should be applied to the special one of septicæmias and other similar general disturbances appearing during the puerperium, for it is only by such knowledge that a sense of the general meaning of the individual cases can be obtained. The description of the organisms has been made as brief as was in the least consistent with a mention of them at all, so that it may seem as if, reading only what is said about them here, it would be exceedingly difficult to separate some of them. But this is not so in reality if the fuller descriptions published in the original articles treating of them be consulted. For example, it is often said in the descriptions that there is no marked characteristic appearance “upon cultivation;” but this only means that there is no one thing shown by the colonies upon any form of nutrient medium which enables it to be identified at once, as in the case of the typhoid bacillus grown upon potato. The minute description of the colonies oftentimes shows a group of characteristics not diagnostic by themselves, but which, taken together, make possible the classification of the organism and its differentiation from others; but this minute description was necessarily omitted as being unnecessary and because of lack of space. The

review of this list of organisms shows us, however, another and extremely important probability that remains to be worked out in connection with them and all others of the micro-organisms; and that is the necessity and possibility of a grouping together of the bacteria by the means shown to us in cultivations. In other words, the classification of bacteria must be, as it is now, of two kinds: first, according to the ideas of the cryptogamic botanists; and, second, according to the convenience of experimental bacteriologists. This latter method is the one of special interest to us as physicians, and to-day consists simply of the extremely rough separation into round bodies (micrococci), rod-shaped straight bodies (bacilli), and curved organisms (spirilla): this is as near to a classification as the bacteriologist can come at present if he depends upon the morphological appearances alone; but if we consider the difference taught by the review of the organisms just made, the same thing being shown with all others yet isolated and studied, we shall see the possibilities of a more satisfactory arrangement from a medical point of view. We see that there are *groups* of these organisms presenting very similar characteristics under the microscope, under cultivation, and more especially upon inoculation: in the latter case certain of them bring out almost exactly the same pathological changes when inoculated in the same way and with the same sort of animal. The lesions they give rise to are similar, but the organisms themselves are different as shown by cultivation, although these differences may not be very marked. Now, considering the micro-organisms to be plants—for their place in the scale of Nature seems undoubtedly to be in this part of her kingdom—it appears not improbable that these “groups” of micro-organisms may be species of which each individual goes to make up a variety, just as in larger members of the same division of Nature there are varieties differing in minor points among themselves, but all possessing the characteristic elements of the family group. This idea, that bacteria, both the pathogenic and non-pathogenic members of the number already studied, possess certain elements in common, bringing them into certain families and dividing them off from others, must be especially prominent in considering those which produce the acute infectious processes rather than the chronic ones. Indeed, our knowledge of the processes running a prolonged course is extremely limited, so much so that it may be said to be confined to one disease, tuberculosis, in which the full chain of evidence required is complete, and therefore any idea of what the future may bring forth in regard to them must be based upon the merest guesswork. With the acute infectious diseases, however, it is different, and more particularly with those under special consideration. In this case we have several groups of organisms nearly alike as shown by the microscope and cultivation. These groups each produce a similar set of symptoms upon inocula-

tion, and the probability of their near connection, as varieties of the same genus, is only strengthened by the most recent researches. These last have shown that, as before mentioned, it is possible to isolate from pure cultures of various organisms certain toxic principles which are possessed of very virulent powers, these powers resembling, in the results that are produced on inoculation, those of the organism grown in the nutrient media in which they are found. These toxic principles are for the most part exceedingly complicated and very unstable, so that they are difficult to isolate or to analyze. But enough is now known about them to show that they are the results of the growth of bacteria in different media, of which the animal tissues are of course the most perfect kind for the pathogenic bacteria, and that they are the result of new chemical combinations made possible by the breaking up of the materials from which the bacteria have absorbed the elements necessary for their own development. These toxic principles exist as the result of most forms of bacterial growth, and, so far as known, produce by themselves the results shown when the organism is itself present and multiplies. Are they, then, capable of being classified together chemically, as we have just seen that certain forms of bacteria may be physiologically, and do these "groups" of bacteria produce the same toxic principles? These are questions that our present knowledge does not permit us to answer with any degree of definiteness, but they are certainly parts of the vast problems in medicine that modern research has opened up for settlement.

Although our knowledge of the ptomaines and leucomaines is so slight compared with what it should be, and will be before many years, that it must almost be said to be none at all—a mere knowledge of the existence of this new field of research—nevertheless, no thorough comprehension of disease can be had from a modern point of view unless we know what they are and what they are supposed to do. The fact that it was impossible in many cases to imagine a channel of entrance made many observers hesitate to accept the assertions in regard to bacteria being the cause of disease. Thus they said, How do the micrococci found in ulcerative endocarditis gain an entrance to the seat of disturbance? They cannot be shown to have got in, and therefore they must be but the accompaniments and results, and not the cause, of disease. This, however, requires that all causes of infectious disease must be shown to have a place of entrance large enough or noticeable enough for us to appreciate by the ordinary senses; which is, of course, absurd. We cannot see masses of bacteria large enough to develop the most alarming symptoms, and it is hardly to be supposed that we can see the lesions necessary for their entrance into the animal tissues; and that we may not appreciate that the lesions present are the channel of entrance for the cause of the symptoms seen is shown by the

fact observed, that bacteria do not always produce local effects at the point of entrance, but may give rise to general symptoms alone or to symptoms localized at a distance from the point of inoculation. Rosenbach's experiments, of making a simple fracture of the hind leg of a rabbit, and then inoculating the animal in the ear with the *Staphylococcus pyogenis aureus*, show this very well, the result of the experiments being the production of an osteomyelitis with abundant micro-organisms at the point of fracture, but no disturbance at the seat of inoculation: the organisms entered the solution of continuity and attacked the place of least resistance, made so in this instance by the intentional injury to the parts of the leg.

In approaching the subject we are about to discuss we are brought face to face again with the old question of the internal or external origin of infectious diseases. The former can hardly be supported to-day because, as has been said, the theory of spontaneous generation has been practically disproved and has no scientific basis upon which to stand, and, on the other hand, the absolute, conclusive proof of the production of every infectious disease by an external cause cannot be conceded until an organism has been found and identified for each and every one of these diseases. This has not been done, and probably never will be, but it is not necessary in several cases, and the more especially in those that are under present consideration. For we know enough now to be certain that not all diseases that have been separated and given names by their clinical signs are due to distinct causes; and, on the other hand, we know that many different causes may produce similar clinical symptoms. And this seeming necessity for the attachment of a special microbe to each special group of clinical symptoms is shown to be no necessity at all by the discoveries that are being made in regard to the products of their activity—the ptomaines and leucomaines. Medical men must come to the realizing sense of the fact that there must be a new classification of the infectious processes represented by the septicæmias and pyæmias, and that not only the clinical symptoms must be considered, but that the etiology of the processes is of even more importance. In this etiology are concerned, as recent investigations show, not only the bacteria themselves as active factors in the production of pathological processes by the absorption of the elements necessary for their growth from the nutritious materials or even the cells of the animal tissues in which they find themselves, but also the class of alkaloids called ptomaines and leucomaines, of which comparatively little is known, although that little is quite sufficient to show their extreme importance in medicine. In considering this class of substances and studying their effect in the special processes under consideration, puerperal septicæmias and pyæmias, it is necessary to take as broad a view of the subject as is the case with the micro-organisms them-

selves. Because if, as we have endeavored to show, many forms of bacteria may be concerned in the production of these processes, it follows with equal truth that many forms of these toxic substances, the product of bacterial growth, may be equally concerned in causing these and similar results. But a difficulty in precise and pertinent statement comes in here for this reason. The study of the individual bacteria and of the lesions in which they are found has not been carried so far that it is possible to state what special form of alkaloid each organism produces, or even whether the toxic products found in the nutrient material after they have grown there are single or multiple; so that, as yet, we are unable to say of a bacterium that it produces such and such alkaloids which will have such and such effects upon introduction into living tissues. This much is known, however: that there are certain substances found in media which have been the seat of the growth of bacteria, and in all such media that have been properly investigated; that these substances are alkaloidal in nature, and possessed of exceedingly powerful toxic properties; that they often occur in numbers of two or three or more in the same nutrient media; and that many of them are so unstable that the use of the processes of extraction yet known only serves to decompose them into simpler substances which may be inert. This instability of character naturally renders the difficulties of this branch of study very great, and the probabilities are that new methods of investigation must be applied before our knowledge in this direction becomes extensive or very exact. That these new methods of investigation will come is not too much to hope, and that their arrival and application will have as great an effect in increasing our knowledge in this direction as Koch's methods of pure culture have already had upon our knowledge of the bacteria is practically certain. In order to a complete understanding of the subject a review, as brief as may be, of our present knowledge in regard to the ptomaines and leucomaines is very necessary.

From the time of the researches of Selmi in 1872 the name of ptomaines has been given to the alkaloids obtained from the putrefying cadaver; and since then Gantier has shown that these animal alkaloids can also form in the living organism and as physiological products of the living cell. To these latter the name of leucomaines has been given; and in the same way as the vegetable cell produces the vegetable alkaloids quinine, digitaline, morphine, strychnine, etc. do the animal cells give rise to the animal alkaloids which are more or less toxic in character. The history of the study of these alkaloids in medicine may be summarized thus: After having found that the infectious diseases, in many cases surely, and in all probably, are produced in the first instance by the entrance into the body of the various forms of micro-organisms, a search was made for the method of action of these destruc-

tive bacteria. As has been well said,¹ the pathological changes produced by infectious bacteria can be conceived of as resulting in two ways: They are either the result of the *mechanical disturbances* the organisms themselves produce, or else their noxious results follow the fermentations they set up; that is to say, that by this latter hypothesis they give rise to true intoxication following this production of toxic substances. But pathological anatomy has left but little importance to suppositions of the first order; the actual mechanical effects of the bacteria are comparatively not many, whilst, on the other hand, the clinical observations of thermometric changes, disturbances of the intellectual faculties, and of the general bodily functions show very clearly that infected tissues are the seat of abnormal chemical changes, of which the toxic products are the cause of the symptoms observed at the bedside; and these products are the leucomaines. The question is still undecided, however, whether these pathogenic alkaloids, these "ptomaines found in the living body," these leucomaines, are in all cases the accompaniments of bacterial activity, or whether they may be formed by the combination of circumstances aside from the presence of the living organisms; but the facts observed and the analogies to be drawn from them point with the strongest probability toward their being due to such activity, and to their not being formed in a healthful animal organism excepting under the influence of the presence of living ferments.

Brieger² says that bacteria produce chemical decompositions in the animal body, and they do, acting in these two ways: 1, by taking for their own use elements which are of importance to, and necessary for, the nutrition of the animal economy; 2, by producing in the tissues that they infiltrate fermentations which result in the separation of certain toxic products of complex character. In a word, they give rise in the animal organism to products of putrefaction, just as cellular life itself produces the same thing in the animal. It is this *vital process* which brings on death, and which gives rise to the cadaveric alkaloids as to the alkaloids found in the fluids during life; in a word, life is a decay (*pourriture*), and a fermentation of the colonies of cells which make up the animal organism, or of the cells which invade and besiege it (pathogenic bacteria), produces ptomaines or leucomaines.

Gaspard and Stich in 1822 observed poisonous properties in cadaveric extracts, but Panum in 1856 was the first to isolate a putrefactive poison whose effects could be compared with the venom of serpents. O. Weber, Hemmer, Sweninger, Stich, and Thiersch concluded from their researches that the poison of putrefaction was of a chemical nature, but were unable to isolate it. Dupré and Bence-Jones in 1866 obtained from animal tissues and fluids an alkaloidal substance to which they

¹ "Action des Microbes dans les Maladies," *Revue scientifique*, Nov. 15, 1884, p. 619.

² *Ueber Ptomaine*, Berlin, 1885.

gave the name of animal quinoidine. Bergmann in 1868, at first alone and then with Schmiedeberg, obtained an azotate crystalline substance from putrefied yeast of beer which they call sepsine, and which they thought they discovered later in septicæmic blood. Sonnenschein and Zulzer in 1869 isolated from the anatomical maceration-fluids an alkaloidal base analogous to atropine and to hyoscyamine, and in 1871 Roersch and Fassbender during certain medico-legal experiments obtained a substance presenting alkaloidal reactions from the liver, spleen, and kidneys. About the same time Schwanert obtained an oily material from the cadaver smelling of propylamine; Marquardt and Hager isolated a substance analogous to conicine, to which Hager gave the name of septicine; A. Gautier discovered a volatile cadaveric conicine, and B. Liebermann and Brands-Krebs found the same thing later (1874). A little later than this Brouardel and Bontney found an alkaloid analogous to conicine in the bodies of many persons poisoned by eating stuffed goose, and a ptomaine analogous to veratrine in the organs of other subjects. Wolkenhaar, Moriggia, and Battistini—Selmi especially, and after him Brugniatelli, Zenoni and Cortez, Dragendorff, Spica, and many others—announced the existence of alkaloids of putrefaction in many important articles. Brugniatelli, Zenoni, and Cortez showed the presence of narcotic poisons and of a base resembling strychnine in corrupted maize. Selmi by the method of Otto-Stas, Dragendorff and Spica by a method of their own, obtained numerous substances with alkaloidal reactions from the organism; Coppola obtained them from fresh blood, Bechamp from the products of stomachic and pancreatic digestion, Gantier, Baldinnio, Bocci, Schiffer, and Bouehard from human urine. But not one of these writers had succeeded in isolating the ptomaines which they had discovered, nor in giving them fixed chemical individualities, and they had not given their composition. This part of the history of the ptomaines begins with the work of Nencki, A. Gautier,¹ Étard, Guareschi, Mosso, Maas and Willgerodt, and Salkowsky. Von Nencki was the first to obtain from putrefying gelatin an alkaloidal base which had the power of combining with an acid to form a crystalline salt: this was Nencki's "collidine." Following him, A. Gautier and Étard obtained two alkaloidal bases capable of giving crystalline salts from putrefying mackerel—collidine and parvoline ($C_9H_{13}Az$). These are all the alkaloidal salts of putrefaction that were actually isolated before Brieger's work. This investigator discovered successively the ptomaine of peptone (peptotoxine), which produces death by cardiac paralysis; the ptomaines of putrefying meat (cadaveric ptomaines), guanidine $C_5H_{15}Az_2O_2$; neuridine, $C_5H_{14}Az_2$; cadaverine, $C_5H_{16}Az_2$; putrescine, $C_4H_{12}Az_2$; saprine, $C_5H_{16}Az_2$; trimethylamine, $(CH_3)_3Az$; and

¹ *Chimie appliquée*, t. i. p. 253, 1874.

mydaleine; and of these alkaloids some are toxic and others not. These are not the only bodies that can be obtained from putrefied infusions of meat, fish, cheese, etc. All of these materials yield a series of extracts with alkaloidal reactions and different colors and precipitates. In fact, one can with the alkaloidal reactions demonstrate the existence of a large number of substances resembling vegetable poisons without ever indicating their chemical character, so that the general reaction for ptomaines, as indicated by Bronardel and Boutmey (a blue color upon the addition of ferrocyanide of potassium and perchloride of iron), is of no value for indicating that great alkaloidal group, the ptomaines, any more than the one given later by Bettrick and Dissel. There are special but no general reactions for ptomaines: if phosphomolybdic acid gives a precipitate with all the ptomaines, it is because this agent precipitates almost all ammonia compounds under any circumstances. Many of the ptomaines are not well determined, but those spoken of last are best known, so far as their chemical composition, characteristics, and toxic effects are concerned. The origin of these ptomaines lies in their formation at the expense of proteid material and under the influence of the life-activity of the ferments and tissues.

Brieger has shown that the cadaverie alkaloids only form in the time of the beginning of putrefaction, to disappear upon its continuation. He has proved that neuridine is formed during putrefaction—a substance that cannot be extracted from albumen or fibrin; and, whatever the special chemical reactions are, putrefaction produces neuridine and cadaverine toward the third day, putrescine on the fourth day, mydaléine about the seventh day, and so on; for it is shown that the different stages of decomposition of dead organs are marked by the formation of basic products, and that many ptomaines disappear with time and are replaced by others. These compounds, although so powerful in their toxic action, are nevertheless, to a certain extent, limited in that action by several facts; their instability renders them especially liable to being broken up into simpler and more harmless compounds; and this is assisted by the continual oxidation going on in the living, and by the presence of the animal heat, which is another element in the production of change in these alkaloids.

In brief, if it be true that the bacteria of putrefaction are capable of producing a variety of ptomaines, some toxic and others not—and this fact is put beyond a doubt by the researches of which we have just spoken; if it be true that this production takes place either directly at the expense of the tissues, or at the expense of non-organized material, albumen, which is not less certain for the same reason; finally, if it is true that this formation of alkaloids is the result of a simple doubling up or a complete destruction of these first materials, whose elements then engage in the synthetic reproduction of the ptomaines;—if all

this be true, we should expect the pathogenic bacteria to possess this power in the highest degree. And it is just this power that they are shown to have by the researches of Brieger, A. Gautier, Villiers, G. Pouchet and Bouehard, and many others.

The difficulty of obtaining pure ptomaines has forced experimenters to use generally ethereal and other extracts, which they transform into sulphates and hydrochlorates, with which more or less impure salts the effects upon animals have been studied. Free ptomaines present sometimes a cadaveric and sometimes a uriferous odor—when not oxidized a virulent odor, such as that of conicine or pyridine. At other times they have an agreeable odor, like orange-flower water, rose, or musk. Most of them possess a sharp taste, which helps toward strangulation if the dose placed upon the tongue be very strong. Some of them are extremely bitter.

The physiological effects (speaking very generally) on frogs are—*a*, dilatation of the pupil, followed by contraction; *b*, tetanic contractions, followed by muscular relaxation; *c*, loss of cutaneous sensibility; *d*, loss of muscular contractility. When dogs are used there is—*a*, irregular and then contracted pupil; *b*, remarkable hyperæmia of the vessels of the ear-flap; *c*, a very slow respiration; *d*, somnolence and stupor, followed very soon by convulsions and death; *e*, loss of muscular contractility.

The other class of animal alkaloids, those formed during life—the leucomaines—are of especial importance from the point of view of clinicians, and should be divided into two groups: those found during normal life, or in health, and those formed during abnormal life, or in disease. As long ago as 1849, Liebig, and after him Pettenkofer, found créatinine in the urine of man and of the dog, but not much was done in the way of following up the meaning of this discovery; and although créatine was found in the tissues, and it was known that it could produce the former by simple dehydration under the influence of salts, acids, or heat, the influence of this property in presenting créatinine in the urine was not recognized; for the same objections were brought against créatine as are now brought against the results obtained in the investigations of the ptomaines and leucomaines—that they are the *products* of the processes to which the animal substances are subjected during extraction, and were not present in the original materials at all.

In 1869, Liebreich found bétaine ($C_5H_{11}AzO_2$) in normal urine, and, in 1880, Pouchet found several alkaloids besides this in the urine.¹ Gautier a year after, and Bouehard² in 1882, both contributed to this study, and Bocci³ showed the toxic properties of the urine by many interesting studies. Munson and Schagdenhauffen⁴ found an alkaloid

¹ *Thèse de Paris*, 1880, p. 21.

² *Leçons sur les Intoxications dans les Maladies*, 1887.

³ *Cent. f. d. Med. Wiss.*, 1882, No. 51.

⁴ *Comptes Rendus*, Oct. 30, 1882.

present in very small proportion in human amniotic fluid, and Lepine and Guerin¹ succeeded in extracting a certain number of ptomaines from certain pathological processes. Gantier, Bouehard, and Villiers all made elaborate researches, the results of which go to show that the animal organism, even in perfect health, produces ceaselessly, and by the very fact of its cell-life, virulent poisons, and that if it does not poison itself constantly, it is only on condition that this production is not abnormally active and that the secretory functions are perfectly performed. There seems to be no doubt at all of the existence of a marked analogy between the products of putrefaction and the results of intra-organic combustions; so that the bacterial destruction of animal tissues can give rise to bases called ptomaines, and in the living body the cells which make it up, when deprived of the influence of the oxygen of the air, can act like ferments and give rise to other alkaloidal substances called leucomaines. There is the same point of departure, albumen, in both processes; there are the same definite terms, carbonic acid, ammonia, phenol, indol, scatol, fat acids, xanthine, sarcine, phosphorus, sulphur, hydrogen, etc.; and in both alkaloids are found. If it be true that bacteria of putrefaction are capable of giving rise to a long series of ptomaines, some toxic and others not; if it be true that this production can be made directly at the expense of the tissues or at the expense of the albumen; if it be true that the formation of these alkaloids is the result of a simple doubling or molecular disintegration, after which the atoms pass at once to the synthetic production of the ptomaines; lastly, if it be true that the living cell is itself capable of producing toxic alkaloidal bodies in perfect health;—if all this be true, we should certainly expect to see diseased bodies and the pathogenic organisms possessed of this power in the highest degree; and this is precisely what modern investigation is showing. Is showing, because we have not yet got far enough to know the actual reactions set up by bacteria in the animal body, and have merely indications of what occurs in a few cases. We know that certain of them have the power of liquefying gelatin, that some of them give rise to gas-production, and that others may set up a putrid fermentation; but we do not yet know much of the products of the combinations or separations set up by these bacteria. Passet has found that certain of the organisms he obtained from pus produced cultures which were capable of coagulating sterilized milk. Harnnek and Passet considered this coagulation to be the result of lactic fermentation. In fact, they established the presence not only of lactic acid, but of certain volatile fat acids in the milk coagulated by the *Staphylococcus pyogenis aureus* and *S. p. citreus*.

¹ "Sur la Presence d'Alcaloides toxiques dans l'Urine et dans Certaines Liquides pathologiques," *Rev. de Méd.*, t. lvi. p. 767, 1884.

Brieger observed that Friedländer's pneumonia-bacillus produced formic acid at the expense of the carbohydrates, and especially acetic acid and ethyl alcohol, and he found that a bacillus which he obtained from human feces, and which always killed guinea-pigs, produced propionic acid in the presence of grape-sugar. This author has done more than any one else in the line of investigation of the pathogenic organisms. In cultures in various media of the typhoid bacillus, besides ethyl alcohol and volatile fat acids, he obtained a base which formed salts with the chlorides of gold and platinum, and which he considers a triamine.

It is perfectly evident that the animal organism attacked by, for example, septicæmia is the seat of very different chemical reactions from those which occur in health; and Brieger has shown this by proving that in diphtheria, erysipelas, pyæmia, and scarlatina phenol is eliminated in much greater quantity than in health.

Very much more information has been gathered, and all tending in the same direction, by Bouchard,¹ Felz,² Lepine and Aubert,³ Villiers,⁴ Pouchet,⁵ LeBon;⁶ and one of the most interesting discussions upon the bearing of these discoveries on modern medicine may be found in the *Bulletin de l'Acad. de Méd.*, 2ème Serie, t. xv. No. 5, p. 175 *et seq.*, 1886.

This review of the ptomaines and leucomaines is necessarily exceedingly brief and unsatisfactory, so far as completeness is concerned, but it will perhaps serve the purpose for which it was intended. That purpose has been, in the first place, to show how vast the subject really is, and how little of it our knowledge embraces; secondly, it has been the desire to bring out these great points, that both living and dead animal tissues are the factories of poisons of great virulence; that in dead tissue these poisons are produced by the micro-organisms, whilst in living tissues they are produced by the vital activity of the cells themselves or of the bacteria among these cells; that the production of these toxic substances during life does no harm, but that they produce poisonous symptoms as soon as their excretion is interfered with or their production is abnormally increased; that the first of these conditions, obstruction to excretion, may occur from various causes, but that both increased production and obstruction to excretion may and do occur upon the entrance of bacteria into the living tissues and their development there. This last point is the gist of the whole matter, and is precisely what occurs in infectious diseases, and especially in those of a septicæmic or pyæmic nature.

¹ *C. Rendus de la Soc. de Biol.*, 1882, Aug. 5.

² *C. Rendus de l'Acad. des Sciences*, 1886, Avr. 12, et 1887, Juin 27.

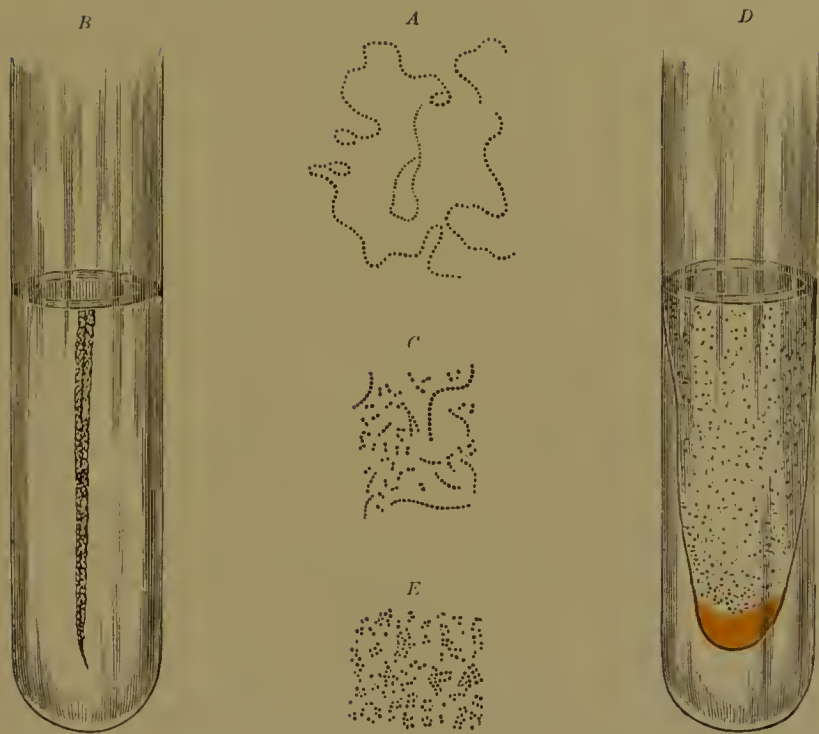
³ *Lyon méd.*, 1885, Sept. 27.

⁴ *C. Rendus*, 1885, Jan. 12, Avr. 20, Mai 11.

⁵ *Ibid.*, 1885, Jan. 26.

⁶ *Ibid.*, 1885, Sept. 21.

FIG. 105.



- A.—Cover-glass Preparation of a Pure Culture, grown in bouillon at 37° C., of the *Streptococcus erysipclatis*. $\times 950$.
- B.—Needle-culture of the *Streptococcus erysipclatis*, grown in nutrient gelatin at 16° to 18° C., four days old. Natural size.
- C.—Cover-glass Preparation of a Pure Culture of the *Staphylococcus pyogenes aureus*, grown in nutrient gelatin. $\times 950$.
- D.—Pure Culture of the *Staphylococcus pyogenes aureus* in nutrient gelatin after eight days at 16° to 18° C. Natural size.
- E.—Cover-glass Preparation of the *Streptococcus pyogenes*, from a pure culture in nutrient gelatin. $\times 950$.

The body is in health ; a wound occurs, as in a woman during parturition ; pathogenic bacteria enter and flourish. If they flourish, it can only be by the taking up of nutritious materials required for the cells of the tissues ; and this absorption goes on in unusual activity, it may be from the tissue-cells themselves, or it may be from the nutritious materials brought to the spot by the lacteals or other channels. In either case the result is the same, and there exists an unusual quantity of elements in a condition of unstable equilibrium, which, following the universal chemical law, seek new affinities and form new compounds, these compounds being, in part at least, of a toxic character and serving to produce the symptoms seen in disease.

The desire has been to show in this paper the nature of the so-called "puerperal fever" as it appears in the light of modern research ; and the effort has been made to show—I. That puerperal fever is not a "specific" process, but only one form, from a clinical point of view, of an infectious wound-disease ; II. That these infectious wound-diseases are never endogenous, but always exogenous, in origin ; III. That they are produced in all cases by the action of living ferments, but that this action may be either direct (destruction of tissue or mechanical obstruction) or indirect (by the production of leucomaines, with the resulting toxic effects of these animal alkaloids produced during life).

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With the close of the chapter just referred to (*Vertebral Artery*, Ligature of the, Heath's "Dictionary of Practical Surgery," vol. II., page 786), my interest in epilepsy did not cease. Indeed, at the time the article referred to was written, most of the investigations and operations now about to be described were complete, and time alone was wanting to realise their value. Sufficient time has now elapsed to test results, and these results are so encouraging and so interesting that I do not think I should withhold them any longer from the profession.

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LECTURER ON THE PRINCIPLES AND PRACTICE OF MEDICINE IN THE EXTRA ACADEMICAL SCHOOL OF MEDICINE, EDINBURGH; ASSISTANT PHYSICIAN TO THE EDINBURGH ROYAL INFIRMARY.

(1884.)

SUMMARY OF CONTENTS.

Chapter I.—The Anatomy and Physiology of the Spinal Segment.

Chapter II.—The General Pathology of the Spinal Segment.—The Alterations in function which result from lesions of its different parts.

Chapter III.—Method of Case-taking.—Summary of Symptoms met with in Diseases of the Spinal Cord.—The Clinical Examination of a case of Spinal Cord Disease.—General Plan of the Diagnosis.—General Plan of the Prognosis.—General Plan of the Treatment.

Chapter IV.—Tabular Classification of the Diseases of the Spinal Cord.—Description of the Individual Affections.

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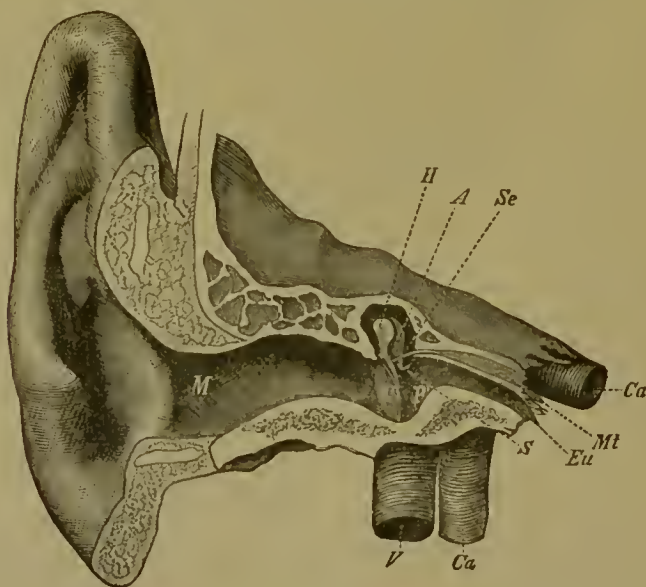
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EDINBURGH.

(1885.)

ABRIDGED LIST OF CONTENTS.

CHAP.	I. <i>Post-mortem</i> Examination.	CHAP.	IX. The Alimentary Canal.
"	II. Pathological Histology.	"	X. Bone and Joints.
"	III. The Liver.	"	XI. Nervous System.
"	IV. The Heart.	"	XII. The Organs of Generation in the Female.
"	V. Blood-Vessels.	"	XIII. Tumours.
"	VI. The Kidney.	"	XIV. Animal Parasites.
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